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APRIL ★ 1946

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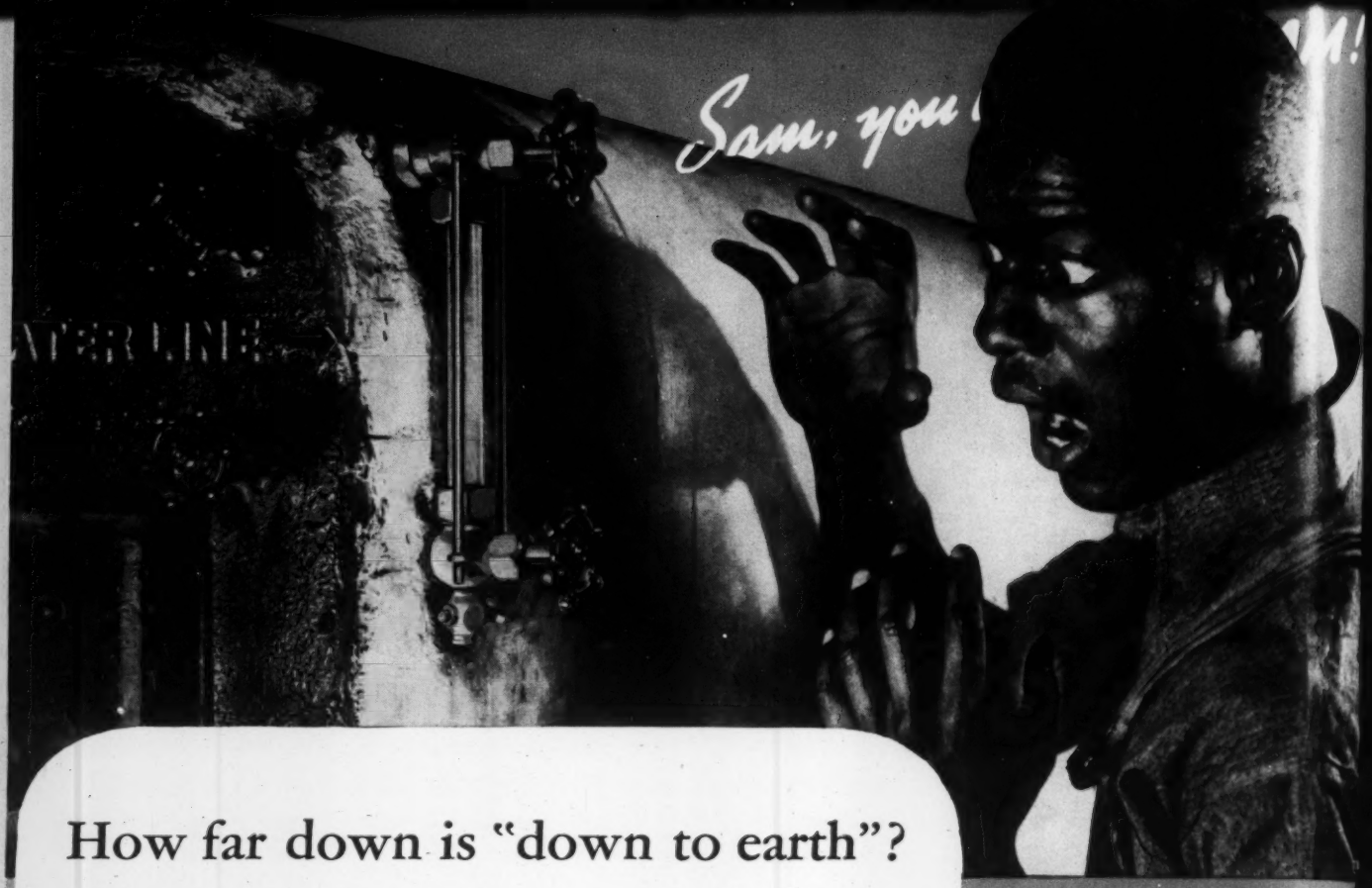
109 — Journal Section of the American Society of Heating and Ventilating Engineers

Construction . . . Industry or Racket?, by Lester T. Avery — page 69

CONTENTS . . PAGE 67



How far down is "down to earth"?

BUSINESS in general, and the building industry in particular, seems to have its feet firmly planted in mid-air! In view of the present muddle, this isn't the least bit surprising. But we sometimes wonder if there aren't a lot of people up in the air who with just a little effort could get back on the ground.

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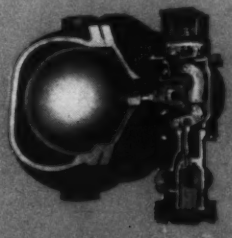

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CONTENTS THIS MONTH

Vol. 18 — April 1946 — No. 4

The Editor's Pages (news, notes and comment) 63

Construction . . . Industry or Racket?, by Lester T. Avery 69

Piping Carbon Dioxide for Fire Protection, by Walter W. Voss 73

Refrigeration for Air Conditioning Aircraft 79

Does Smoke Abatement Pay?, by J. H. Carter 80

Pipe Specifications, Insulation Standards Developed by ASTM's Technical Committees 85

A Simplified Procedure for Specification Writing, by George W. Campbell 86

Using the Reverse Cycle for Heating, Conditioning, by G. E. Clancy 90

Check Your Insulation for Better Fuel Utilization 94

Sam Lewis' Page—War Plant Wasted Lots of Fuel; Changes Made Save 26 Per Cent 96

Air Conditioning Prevents Roof Falls in Coal Mines 97

Meetings and Conventions (many scheduled) 98

Midwest Power Conference (excerpts from papers) 99

Boiler Plant Operating Errors, by Carroll F. Hardy 99

Cooling Tower Selection, by J. Lichtenstein 101

Centrifugal Compressors, by E. P. Palmatier 103

Radiant Heating, by T. Napier Adlam 104

Contractors Issue Radiant Heating Bulletin 105

"Open for Discussion" (comment from readers) 106

What Air Conditions Make for Comfort in Industry?, by H. A. Mosher 106

Use Floor, Wall, or Ceiling Coils for Radiant Heating? (discussions by C. A. Hawk, Jr., and by D. L. Mills) 107

Equipment Developments (new products reviewed) 163

Recent Trade Literature (manufacturers' data available) 186

Index to Advertisers 204

Journal Section of the American Society of Heating and Ventilating Engineers

The Influence of an Interior Coating of Aluminum Paper on Internal Thermal Conditions and Heat Economy, by R. J. Lorenzi, L. P. Herrington and C.-E. A. Winslow 109

Effect of Branch Take-Off Design on Noise in Ventilating Duct Systems, by Oscar Imalis, F. C. Houghten and Clark M. Humphreys 115

New Research Laboratory Building Purchased 119

Summer Meeting Cruise on the St. Lawrence 120

Summary of Local Chapter Meetings 122

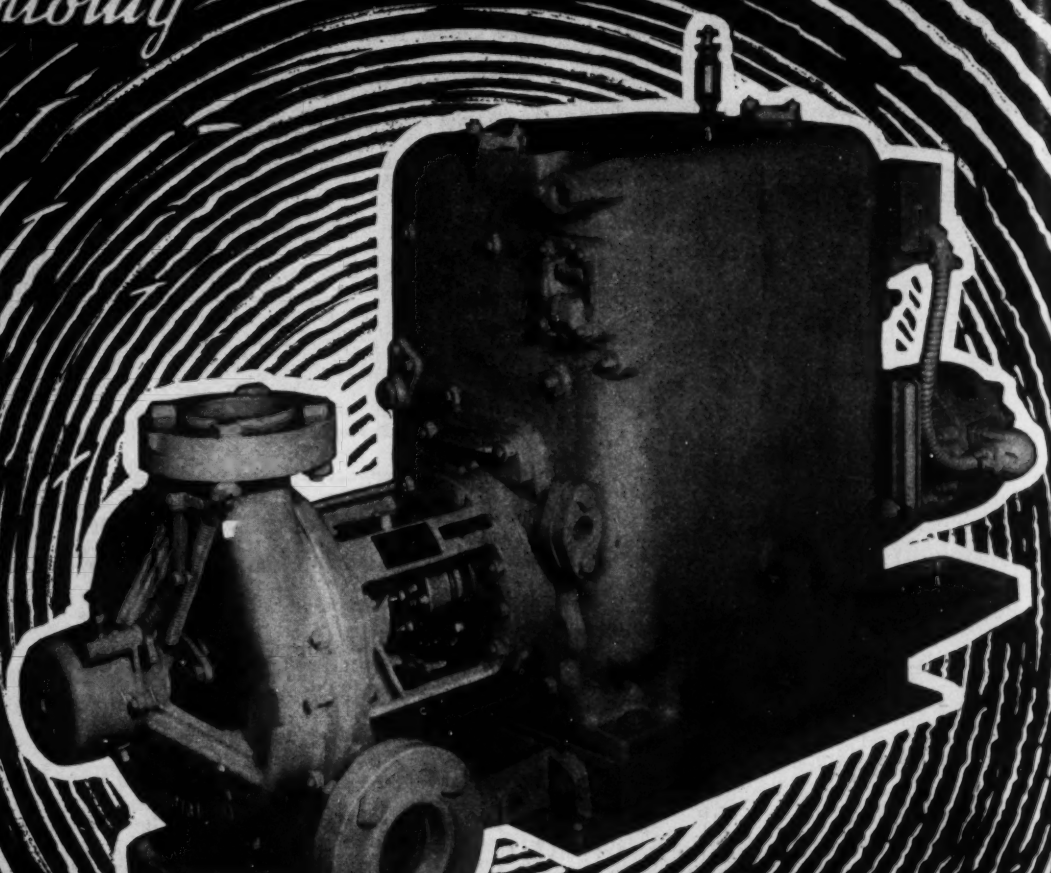
Chapter Delegates Meet and Elect Leser 126

Candidates for Membership 128

Candidates Elected 130

Officers, Council, and Committees 131

Centralized Heating Economy



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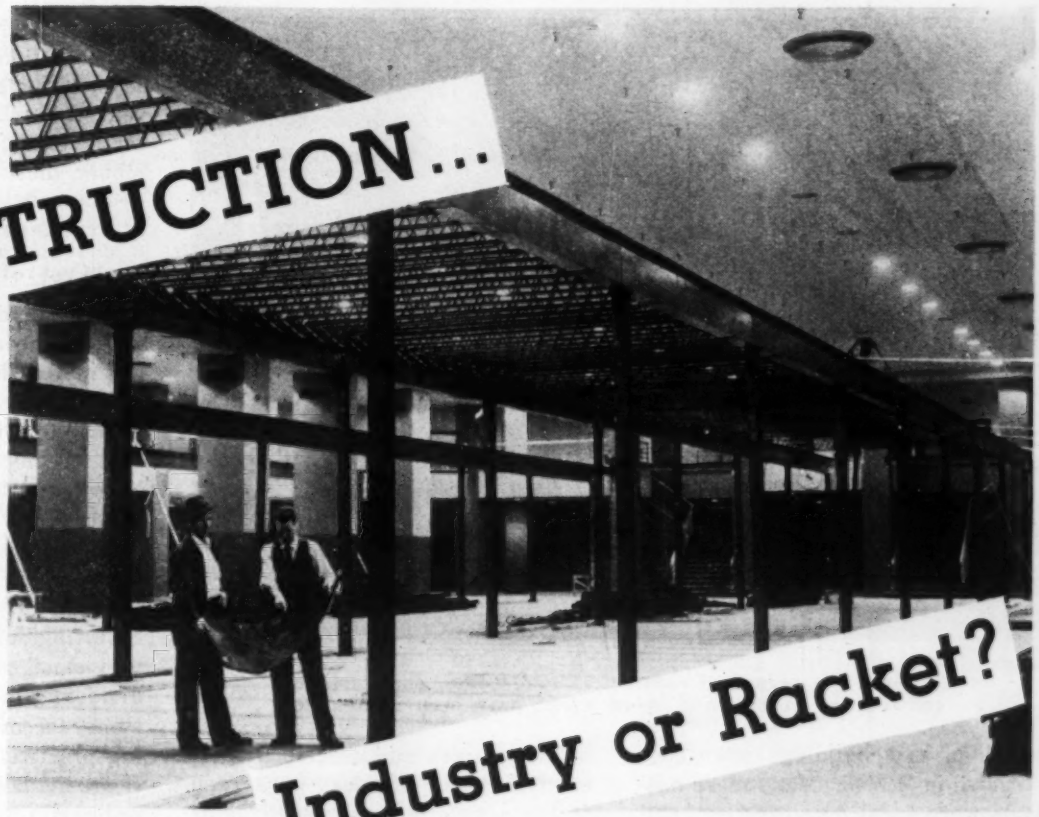
CONSTRUCTION... Industry or Racket?



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ARCHITECTURAL FORUM, in its January '46 issue, said: "On the spot as never before, Building was running out of chins on which to take it." One of the big weekly magazines, Life, ran a feature article in December '45 that carried pictures and charts and let loose this haymaker, "Never was there an industry which so little deserved the coming boom or was so unready to rise to the occasion. . . . If the housing industry had done even a passable job in 1910-1940 we would not be in this jam today. . . . As now organized, the building industry just doesn't give enough house for the money."

Right now it is popular to berate the construction industry, to call it names, and to blame the ills of the housing shortage on unverified gossip. Is there no one to say a word for this much-maligned industry of building? Does everyone know what the building industry is and how it got that way, and why? If you tell a man he is a crook and a racketeer often enough, he may try to prove you are right. If you need more people, more honest workers, and more contractors in order to "deserve" the coming boom, will they be attracted by this kind of publicity? First of all, is this smear campaign deserved? Who is being smeared?

What Is the Building Industry?

The building industry is composed of manufacturers of building materials, architects and engineers who design the buildings and specify the materials, distributors and supply houses that wholesale the materials, contractors and subcontractors who have the special knowledge and skills to incorporate the materials into the building. The real estate dealer is included, as he provides the land. Banks and insurance companies supply the financing. The municipal government is involved because it generally paves the streets and makes water and sewer connections. The utilities participate, as they furnish gas, electricity, and transportation. We can't jump into the middle of this group, start swinging widely, and hope to bring salvation! They are not all sinners!

There are many problems in the building industry but they require creative corrections, not distorted half-truths, and the problems fall into patterns of material prices, building trade wages and practices, contractor's contribution and cost, building codes, and financing costs. Let's look at a few of these problems and try to work out some constructive improvements.

Just before the war, Thurman Arnold made a lot of headlines trying to ferret out and destroy the "combinations in restraint of trade" that allegedly plagued the building industry. Nothing much came from this attack, except the generally accepted idea that the building business is a crooked one. The heat was turned off in 1941 in order to get on with the war construction program. We haven't the time here to review what the construction industry did in the early war years to create the plant that made the production that equipped the men that won the war. In the Cleveland area alone, $175,000,000

Lester T. Avery, President, Avery Engineering Co., Defends a Much-Maligned Business . . . . . Building

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Without the organized contractors and trades, our wartime construction volume and speed would have been impossible

worth of new buildings were constructed in '42-'43. Many more millions were spent on alterations and improvements to old buildings. Thousands of housing units were built. The important point is that there was such an industry that was ready, willing, and able—and without the organized contractors and trades, such construction volume and speed would have been impossible.

Barrage of Vicious Attacks

Now—in the postwar era—we start with a barrage of vicious attacks on the several branches of the industry, as if in so doing we could solve the general problems of shortage of housing space and increasing costs. It seems to me a lot of people —feature writers, newspaper reporters, columnists, radio commentators, and after-dinner speakers—have suddenly found it popular to take pot-shots at the building business.

I assume many of them are sincere and simply haven't had the time nor the inclination to learn why there is such an industry, and why some of these apparent evils are a relatively minor end result of a number of very important trade practices. Let's take a look at a few of these recent attacks.

Time magazine carried February 11 a good article on housing, dealing particularly with prefabricated homes, and mentioned a number of manufacturers and described their contributions. The last paragraph of the article is so vicious I quote it here: "Even if prefabricators do get into large scale production soon, they will still have one hurdle to jump, highest of all. Many a U. S. town, spurred by featherbedding unions and building contractors, has building codes which ban prefabricated houses outright, or contain tricky regulations which factory built dwellings cannot meet. And many a buyer will also find that members of the AFL's building trades unions will not wire, install plumbing, or assemble a prefabricated house."

In starting a series of articles on building, the February 7 Cleveland News ran a column heading reading "Building Industry Puts Homes Out of GI Reach." The article pointed out and diagrammed how the builder must deal through 13 subcontractors and said "each subcontractor makes an average *gain* of 10 per cent above the actual cost of labor and material going into that home." To the layman that means that the cost is increased 13×10 per cent, or a total of 130 per cent! Terrible, isn't it? (But very, very far from true.) The payoff comes a couple of paragraphs later, when the writer of the story discusses his own preferred diagram—where the builder (presumably the general contractor) buys the materials from the jobbers and hires the building trades unions direct. The writer says, "The builder cannot circumvent the subcontractor and go directly to the source of supply, the jobber, distributor or manufacturer —unless he is ready to meet a lot of *expensive* trouble."

"Cost of Doing Business"

What kind of trouble? It's the trouble the subcontractor takes to get materials and men on the job economically at the right time, for which he may charge this 10 per cent or more *on his own costs of labor and material* which, in reality, is his "cost of doing business."

A contractor or subcontractor must pay his cost of selecting, purchasing, supervising, guaranteeing, collecting, and paying out of this very small margin—and on any individual job he may actually lose money according to good accounting practice. At the year's end, he closes his books and looks for profit, ordinarily a fraction of 1 per cent. The meat industry has greatly publicized the fact that only a fraction of 1 per cent of each dollar *gross* business is profit. Contracting is a similar business. Materials are bought on the hoof, cut up and processed by skilled mechanics, and a usable building results. Let's stop this confused thinking and talking as if the margin of markup was *profit*. The only reason people even dream such things is that the contracting business has always been working in a goldfish bowl where the outsider hears of this markup—particularly on cost plus work. What does he know of the per cent markup over *cost* of the automobile industry, which is held up so frequently as the wonderful example of low cost operations? You can be sure that when wage increases are allowed in the building trades, they are passed on promptly to the consumer as there never has been any claim that the contractor's margin was adequate to absorb any increase in costs.

Why So Many Small Contractors?

You might inquire why there are many small contractors. The magazine Life says, "At present the average corporation in this field has less capital and its workers have less machinery to work with than any other major industry, even in-

cluding agriculture." . . . So what? Here is a great example of the democracy of American business! Any mechanic can buy the materials, hire a man to help and, presto-chango, here is a new contractor. The competitive bidding system, the method by which the architect or owner determines he is getting a fair "competitive" price, encourages this practice.

But here is a paradox: The more contracting you do, the greater the cost of supervision or contractor's overhead, so the small individual operator can always underbid the larger, well organized contractor. I am not arguing in favor of small contractors as compared with larger ones but simply pointing out the error in the above-mentioned implication that these small, no capital builders are a cause of high costs. Many of them charge very little above their cost for materials. Are not these operators the ones most frequently called "jerry builders" and "alley tinsmiths"? They are cheap, but lack that element of responsibility so important after the job is finished. As long as the owner or his architect wants competitive bidding, we will have opportunities for the mechanic to become a small contractor, then a larger one, then to join a trade association and complain bitterly about "cut-throat competition" from the "small, unreliable outfit."

Let's get the record straight as to contractors and their percentage above cost. There may be three to 10 subcontractors on a house, each of whom is contributing his particular labor and material and, therefore, charging an overhead, but this charge is based only on his own work. The general contractor may be the carpenter or masonry contractor or he may be a broker with no direct labor of his own, but he charges a small overhead fee for his skill in coordinating the entire project. The more of the work the general contractor does, the more fee he has to charge. The owner *can* eliminate the general contractor entirely and sublet all trades separately. In this case, he saves the general contractor's fee but he must give the job the same supervision and coordination. Thus we see that the subcontractor or general contractor fee above cost is not a tribute extracted because of some artificial barrier but is the fee paid for skilled supervision — professional service, if you like—and it is simply the jargon used to describe the contractor's cost of doing business. Just another case of "Who pays who how much for what?"

Why Are There Building Codes?

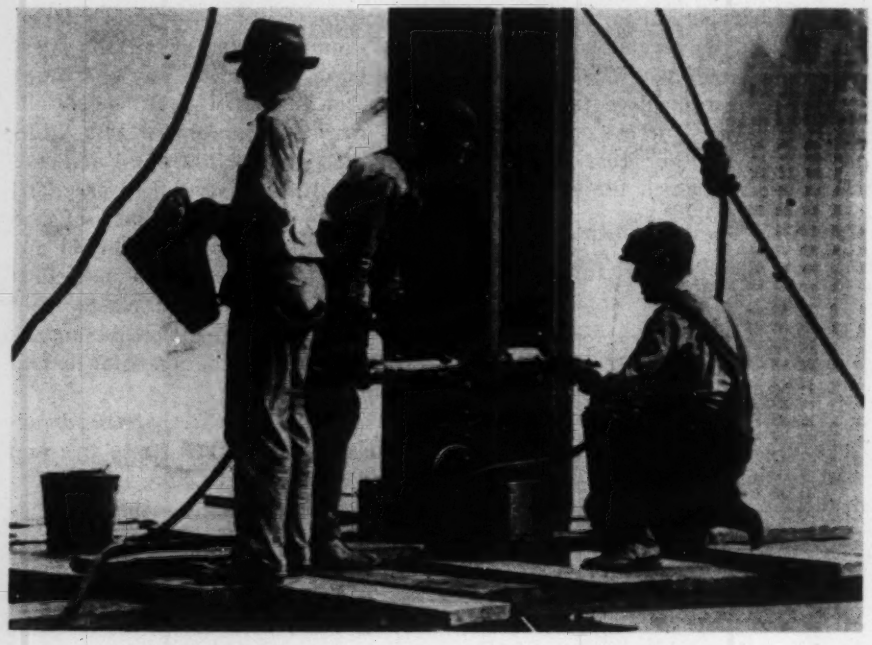
A Cleveland paper ran a story February 8 on the burning of a building in a suburb, which fire had cost 14 lives a few days before. The article contained a few significant sentences which are quoted here. "Representatives of the [company] said to have been suppliers of the heating plant and the prefabricated materials of which [the hall] was built will be requested . . . to help complete an inquiry into the cause of the fire that cost 14 lives. It was disclosed by [the mayor of the suburb] that the suburb had declined for several weeks to issue the permit to build the home and had not given permission until the permit had been approved by the state building inspector. [The mayor] said the specifications did not conform to the [suburb's] building code. . . . In an examination of the home's insurance policies, he [the insurance adjustor] found the loss of the building only partly covered."

It certainly is not my intent to pass on the merits of this particular case, and I mention these quotations to bring up the point so many forget. Why are there any building codes? Why licensed contractors, a new form of control coming fast? Why pay a fee for a building permit and another fee for inspection of electrical work, plumbing, heating?

Well, who *is* responsible when a building burns down so rapidly you can't get a few people out? Who is responsible if sewage crosses over into drinking water lines and causes sickness and worse in an apartment or hotel? Who is to blame if a light switch gives you a shock which may stop your heart or drop you onto a cement floor with a broken limb? Does the owner pretend to have the expert knowledge of these mechanical trades so that he feels qualified to buy the materials from the mail order house and install them with the help of his relatives, friends, or domestic servants? He can do just that if he wants to—even in a large city—but he must go all the way. The home owner can buy and build any way he wants to, but he should not start a program of this kind and then change his mind and ask for help from the skilled mechanics or contractors on part of the work. And he certainly should not penalize his bank or his insurance company—yours and mine, too—by building something that is unsafe and that may cause financial loss to others.

The point here is that the insurance companies that write fire and liability insurance, the banks and insurance companies that finance buildings, and the state which supervises through workmen's compensation the welfare of the worker, all *must have, and demand,* some control of building; this requires city, state, or even national codes. I hold no brief for codes that are discriminatory, or that unnecessarily increase costs, but who is to be the judge? We have a driver's license law in Ohio, and we require anyone responsible for an automobile accident to pay the damages or he loses his license. This has brought with it plenty of criticism and probably abuse, but there is no considered opinion now to discontinue this licensing. In other words, the automobile driver must be responsible for damage he causes. How can the home owner or large building owner be made equally responsible? He protects himself with insurance and the insurance companies want the building built and kept up to "standard." That influence has more to do with the allegedly restrictive building codes

IT'S A POPULAR sport with a lot of people—feature writers, newspaper reporters, columnists, radio commentators, after-dinner speakers, and others—to take a crack these days at the construction industry. Some of this criticism may be justified, but too much of it is far from reasonable and far from being helpful. . . . In this and a succeeding article, Mr. Avery—who has been pretty close to the construction industry for many years, and knows what he's talking about—attempts to put a few things straight. What's your view?



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Right now, it is popular to berate the construction industry

than anything the labor unions or contractors have ever promoted. The sins of the few start the demand for laws governing everybody and the building industry is no exception.

Now an old code restriction in Chicago is going to be enforced that has been generally ignored—the restriction on directly connecting a refrigerating condenser to the city water lines. A condenser leaked and the refrigerant got into the drinking water lines for the neighborhood, so now all condensers must be separated by an open tank from the city water supply. That will increase the cost of food refrigeration and of air conditioning.

A new building code is being considered in Cleveland that will increase cost. It is 500 pages long, a result of years of work. One of the provisions is to eliminate the use of joist space and stud space as air ducts in a heating system. This is required by the fire department and the fire insurance companies, who have determined that warm air ducts should not be in inflammable wood. Any of you can cite similar code restrictions that increase cost, but they originated in health and fire departments — not in labor unions or contractors "featherbedding."

One of the criticisms of the building contractors is their indifference to the enthusiasm of the man who wants to save money by doing some of his work himself. He has a friend who can "get it for you wholesale" or he is skilled as a painter or something. Maybe he shops around and gets all his materials together and then wants a contractor to install, and runs against the stone wall—"No men available." What's wrong?

"Get It for You Wholesale"

I'll illustrate this by referring to the automobile trade, which is held up as the example for the building trades to copy. Would you buy the brake lining, the spark plugs, and the valves for your car at the "5 & 10" and take them to your dealer to install? Any contractor or service company *must* sell materials and get that margin to help out on labor. You just can't charge enough on labor alone to stay in business. So the owner or novice contractor is hard put to it to find anyone interested in selling labor when there is no material to sell.

The extreme of this condition is for the contractor to charge as much for the labor alone as if the materials had also been sold. This phase of contracting is very hard for some to understand and has caused lots of headaches, but it is a very simple economic fact. If you don't sell the materials, the labor has to carry the load. I knew a man in our town that started last July to build a house for himself. He bought some materials at second-hand stores, some from wrecking companies, some from mail order houses. He can't get his house built. He is short *some* materials. He can't get labor. He's frustrated. If you are going to build without going through the regular channels, better do it on the farm, where the neighbors will pitch in and help with the "barn raising."

Installing Prefabricated Products

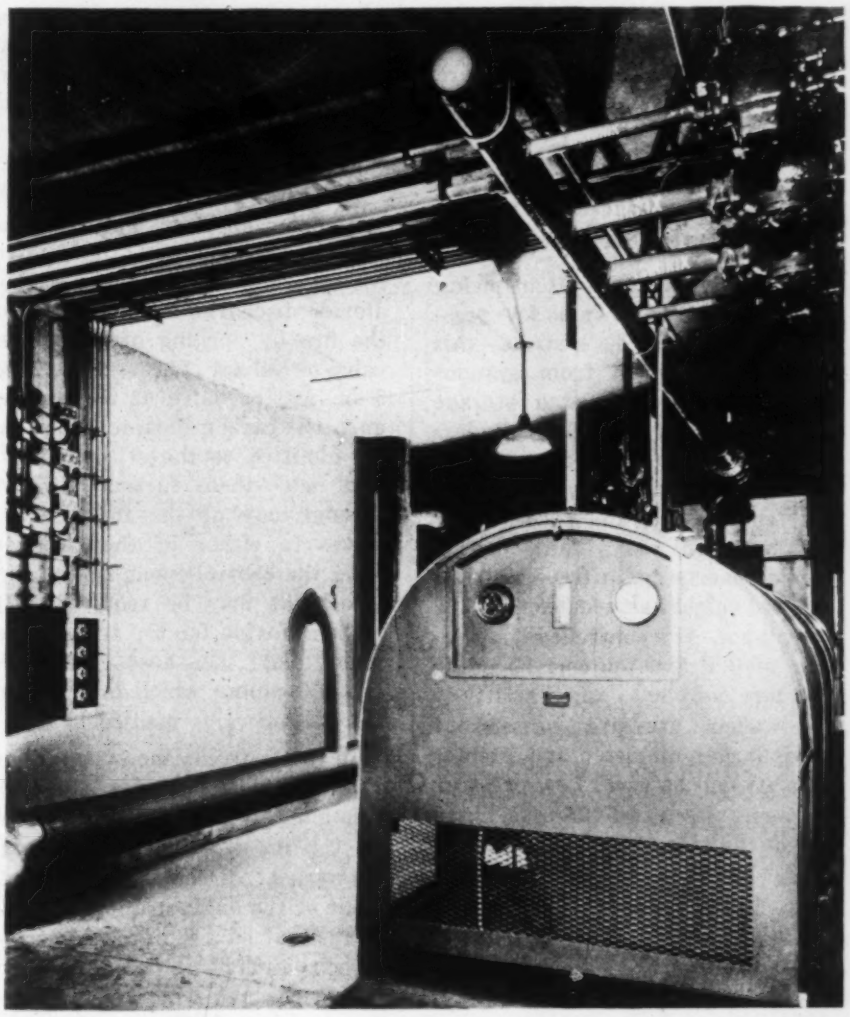
We should recognize the very important and valid criticism of the building trades in their lack of cooperation in installing prefabricated products. There never has been any trouble installing prefabricated materials such as windows, screens, furnaces, etc., no matter where made. The trouble starts when prefabrication is really assembly, and the assembly is done by nonunion shops—as was the custom before CIO or, more recently, in CIO union shops.

Let's be practical about this problem. If the AFL is the building industry union, let's get a working basis for using the prefabricated houses and factories. It might be a good starting point if we recognized that the AFL had organized the building trades many years ago, had worked out their agreements with the contractors' associations, and had received government cooperation in their most trying days. The simplest solution might be to organize the shops which do prefabrication as AFL shops.

This has been done in some cases, but I can see where the CIO, which is now firmly established in the automotive and other manufacturing plants, will expect to carry over into the new work of prefabricating houses and portions thereof. The problem isn't simple but it is plain. If you can assure the AFL mechanical trade unions of *all* the work they can *ever* want *in the field* and can satisfy their union officials that they can never organize the shops doing the prefabrication, then the AFL will connect up these prefabricated items. This problem must be settled before you throw the construction industry into a fight which stops construction.

[In a second article, Mr. Avery will "get down to cases" on the subject of building costs, and will have more to say about organization of shops engaged in prefabrication.—Ed.]

Walter W. Voss Outlines Requirements for Piping Layout and Installation



Ten ton carbon dioxide storage unit showing master valve manifold and pilot piping

PIPING CARBON DIOXIDE for Fire Protection

PIPING liquid carbon dioxide speedily into burning airplane motor test cells at the crucial moment saved many valuable motors from the scrap heap during the war years. Piping systems designed to serve this purpose permitted the quick distribution of liquid carbon dioxide from a large central source of supply under uncommon combinations of pressure and temperature conditions.

In spite of all precautions taken when airplane motors are given their gruelling fitness test, accidents happen. Fuel lines break and spray potent high test gasoline over hot exhaust pipes, engines backfire through the carburetor, and cylinder heads blow off, spattering hot oil and gasoline about. In an instant, violent flames engulf the whole engine. Unless such a fire is extinguished promptly, the terrific heat in a short time burns and warps the delicate machinery beyond hope of salvage.

Such spectacular service rendered to the airplane industry naturally overshadowed the somewhat less dramatic role played by these systems in guarding numerous other hazardous industrial processes.

For instance, liquid carbon dioxide systems stand in constant readiness to snuff out oil quench tank fires which frequently develop when red hot steel is lowered into the oil bath for heat treatment. Furthermore, flashy and intense fires of solvent vapors characteristic of paint spray booths and metal washrooms are made to yield quickly under the prompt application of the potent chemical. Also safely protected are such danger spots as gasoline storage and pump rooms, transformer rooms, and the like—to name only a few of the many typical areas where a fire may wreak great havoc.

Why CO_2 Is Useful

The usefulness of carbon dioxide as a fire extinguishing agent derives from several valuable qualities. It is inert, nondamaging, cooling, and relatively inexpensive. It is a nonconductor of electricity and leaves no residue to be cleaned up after extinguishment.

Most combustible vapors, such as those from gasoline, oil, and other flammable liquids, will not burn if the oxygen concentration in the air is reduced from the normal 21 per cent to approximately 14 per cent by volume. By adding a sufficient quantity of carbon dioxide to air, the oxygen concentration is readily lowered below this point and the fire simply dies out from oxygen starvation.

To minimize fire damage from a gasoline fed blaze, the extinguishment must be quick and sure. This is only possible by injecting into the burning space large quantities of carbon dioxide at a high rate. It calls for an ample carbon dioxide supply and a piping system capable of rapidly carrying the carbon dioxide from the storage unit to the fire.

Extinguishment is accomplished either by flooding the whole space being protected or, if the fire is likely to be localized, by direct application, from a fixed nozzle or a nozzle attached to a hose line and handled by an operator.

Large quantities of carbon dioxide in liquid form are conveniently stored at 300 psi gage pressure and 0 F in insulated and refrigerated storage vessels, such as the one illustrated.

Use of Refrigeration to Control Pressure

Fire extinguishing systems using this method are known as low pressure carbon dioxide systems—this distinguishes them from systems employing unrefrigerated storage in small capacity (50 lb) cylinders at considerably higher pressures. The use of refrigeration to control the temperature, and consequently the pressure that liquid carbon dioxide exerts against the walls of a closed vessel has wide commercial acceptance. At a controlled temperature of 0 F and the corresponding pressure of 300 psig, relatively thin-walled pressure vessels of much larger diameter and greater capacity can be used. Low pressure storage units up to 125 tons liquid carbon dioxide capacity have been built. However, vessels for most fixed fire protection installations range from ¼ to about 20 tons capacity.

Liquid carbon dioxide is crystal clear, has water-like fluidity and its density at 0 F is almost the same as that of water. When released through a nozzle into the atmosphere, this liquid transforms instantaneously into part vapor and part "snow" (carbon dioxide snow, which, in compressed form, is known as dry ice). The expansion from the standard storage conditions of 300 psi gage and 0 F yields 47 per cent snow at the exceedingly low temperature of —110 F. Under these conditions, a pound of carbon dioxide can absorb 150 Btu and provide considerable cooling effect. The formation of the dense snow makes it possible to project it readily to the seat of the fire, where the cooling and smothering action is most needed. When vaporized to room temperature (70 F), 1 lb of carbon dioxide occupies 8.85 cu ft.

Piping Layout for Typical System

A typical piping layout for protecting two airplane test cells, a control room, a transformer room, a pipe trench and the roof is shown schematically in an accompanying figure. A 4 ton storage unit near the cells holds an amount of carbon dioxide sufficient to extinguish any fire likely to develop in the hazards, plus adequate reserve for new emergencies.

A master control valve manifold at the storage vessel and a selector valve manifold near the control room permit direction of a carbon dioxide discharge to the location of the fire by opening of the proper valve or valves. Through the large 3 in. master valve at the storage unit, the carbon dioxide liquid can be admitted to the selector manifold and then further directed through any of the four selector valves to either of the two test cells, the control room, or the pipe trench, as may be required. The carbon dioxide for the transformer room and the hose reel runs through piping which branches off the master valve manifold.

In the test cells the strategic positioning of the nozzles materially aids quick action. Two nozzles, fed by 1¼ in. supply lines, discharge downward directly toward the front of the engine; another nozzle at the end of a 1 in. pipe releases carbon dioxide into the so-called barrel, through which all oil, gasoline, and control lines enter the engine. Still another nozzle on a ½ in. line injects carbon dioxide into the carburetor air duct. The first three nozzles are of the type illustrated in the picture of a total flooding discharge nozzle. The discharge of carbon dioxide issuing from these nozzles serves to knock out a blaze at its source. The carbon dioxide streaming into the carburetor air duct through a small orifice type nozzle is for the purpose of stopping the engine quickly.

The effectiveness of this setup has been demonstrated many times. One fire protection system was called upon 37 times during 1944 to extinguish fires caused by the breaking of gasoline or coolant lines while the engines were running. In no case did the engines suffer damage beyond some burnt insulation of electrical lead wires. By injecting carbon dioxide into the carburetor air duct, the propellers are usually stopped within 30 sec, so that the full undiluted smothering and cooling action of the carbon dioxide is brought to bear on the seat of the fire during the remainder of the total 1 to 4 min discharge period.

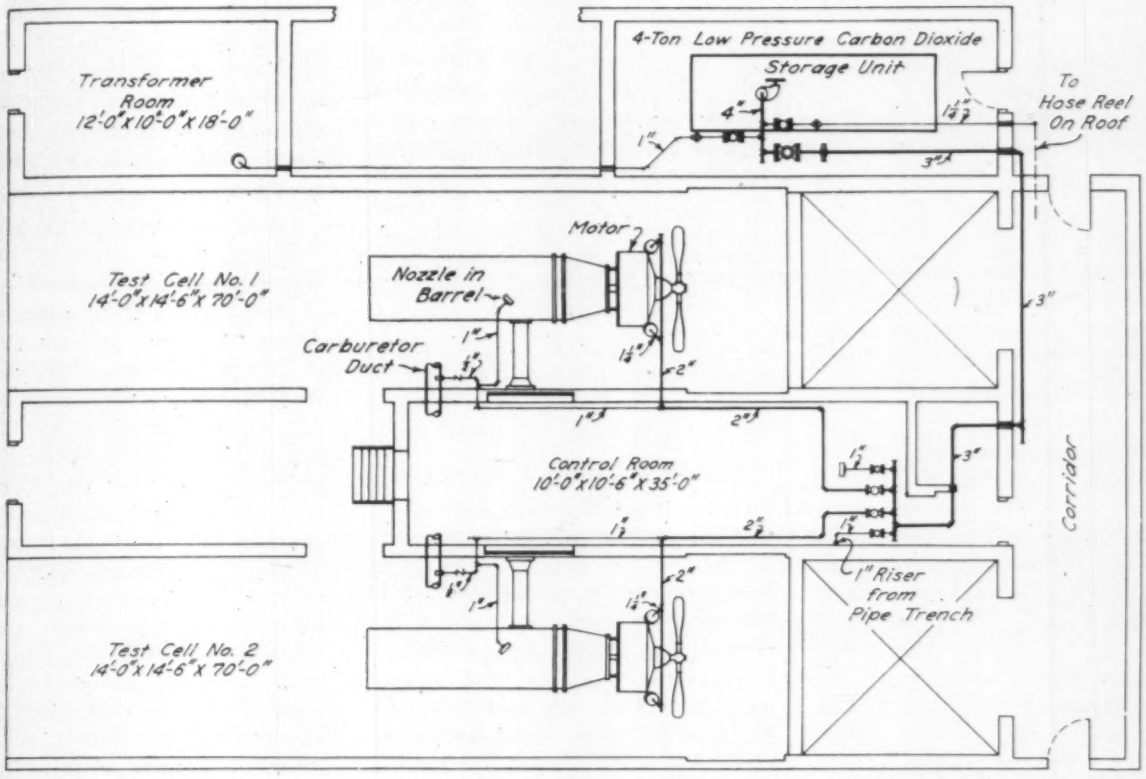
In the installation illustrated, the total discharge period for each test cell is 2 min, during which time 1,800 lb of carbon dioxide can be applied. The actual extinguishment of most test cell fires is normally accomplished within 30 to 45 sec. Prolonging the discharge beyond this time provides a margin of safety and serves to assure thorough cooling of all hot surfaces to eliminate the possibility of re-ignition.

Protection of the control room, which contains many valuable instruments and gages, is afforded by total flooding. Admitting 500 lb of carbon dioxide in 1 min to this room through a 1 in. supply pipe and nozzle provides positive extinguishment.

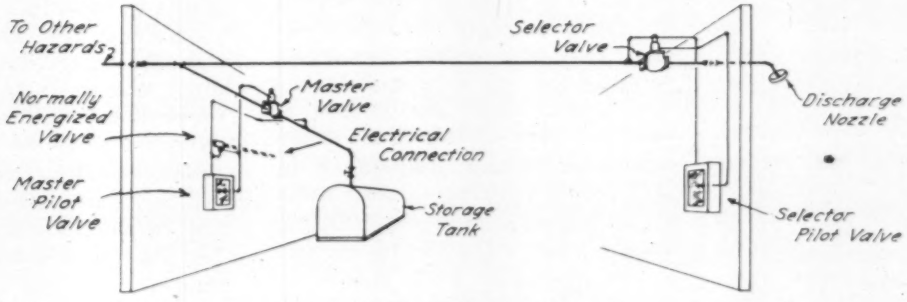
The approximate length of pipe of various sizes through which the carbon dioxide must travel to reach each of the hazards from the storage tank can be roughly ascertained from the schematic drawing. Discharge rates and the automatically timed discharge periods are given in Table 1.

From this typical system the ba

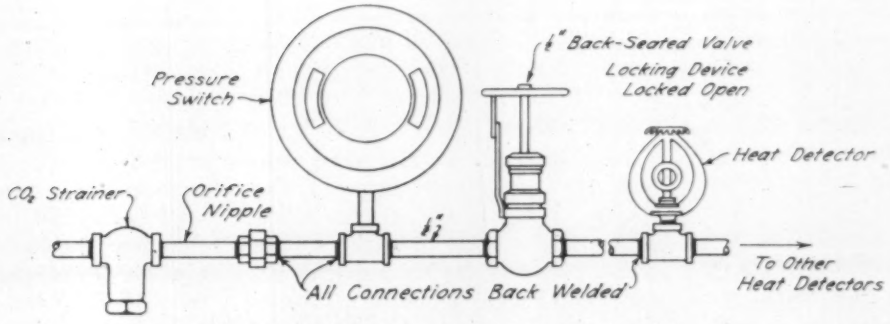
QUICK DISTRIBUTION of liquid carbon dioxide from a large central source of supply under uncommon combinations of pressure and temperature conditions is a vital industrial service in which piping plays a major part. Mr. Voss, research engineer with the Cardox Corp., describes here the layout, installation, specification, testing, etc., for such process piping. . . . The type of piping layout developed for this application has contributed measurably to the reliability of fire protection by means of low pressure carbon dioxide systems. Safe and certain fire protection of valuable or hazardous storage or processing relieves much risk and ensures against costly loss of equipment, material, and irreplaceable production time—and it saves lives



Layout of Piping System
For the Protection of Two Airplane Test Cells and Associated Hazards



Pilot Piping System



Details of Explosionproof Detection System
Operated by Carbon Dioxide Vapor

sic pattern of a low pressure carbon dioxide fire protection system becomes readily apparent. The main items for storage and distribution

Table 1—Carbon Dioxide Discharge Data

Hazard	Discharge Rate, Lb per min	Time, Min
Test cell	900	2
Test cell	900	2
Control room	500	1
Hose heel on roof	250	As may be required
Pipe tunnel	300	1
Transformer room	175	1

are a liquid carbon dioxide storage unit with a tank shutoff valve, a master control valve near the storage unit, piping to a hazard group, selector control valves for each hazard, and the piping into the hazard —together with a suitable discharge nozzle or nozzles. Naturally, a complete system involves a control arrangement for timing the opening and closing of the proper valves and a means of initiating the control system, either by an operator or automatically. The discharge cycle may be started either automatically or manually by means of an electrical control system, or in the event of current failure, the control valves can be operated by opening conveniently accessible pilot valves. All control valves are actuated by the carbon dioxide pressure itself. Small electric solenoid operated pilot valves or supplementary hand operated pilot valves admit or release pressure to operate these control valves.

A Good Piping System

It is evident that a fire extinguishing system must be ready to function in all respects at any time; therefore, extreme reliability must be built into all its parts. This is achieved by simplicity of design and construction. In harmony with this need, rigorous specifications govern the piping installation and the exercising of particular care on the job is naturally demanded.

A good piping system starts with an intelligent layout and with the proper sizing of the pipe. For carbon dioxide flow, pipe sizes are so selected that the pressure at the nozzle is always well above 60 psi gage. The fact that liquid carbon dioxide flashes into snow and vapor at this pressure requires this precaution, for if during the discharge the pressure in the pipe drops below this value and snow formation takes place, the partial or complete obstruction of one or more nozzle orifices could reduce the discharge rate considerably. The schematic diagram and the data in the table indicate in general the relationship between lengths of run, flow, and the corresponding pipe sizes which assure pressures at the nozzle safely above the minimum to prevent snow blocking of the orifices.

Piping Specifications

The valves in the pipe lines divide the piping system into three sections which, because of the different service required of them, are governed by somewhat different specifications.

Since the short piping between the storage unit and the master valve is continuously under the 300 psi storage pressure, extra heavy steel pipe with welded fittings or flanges is prescribed. Welded piping with extra heavy socket weld fittings up to 2 in. diameter, or regular extra heavy steel welding fittings for larger diameters are employed. Butt welded piping for sizes up to 2 in. is acceptable, but for larger sizes, lap welded or seamless pipe is required. Alternately, up to and including 3 in. size, screwed piping is permissible when forged steel screwed fittings are used and when the connections are subsequently back welded on the job. Testing with soap solution must disclose absolutely no leakage, since loss of carbon dioxide from the supply cannot be tolerated. One of the sketches shows piping details at the storage unit of a 10 ton installation with four master valves.

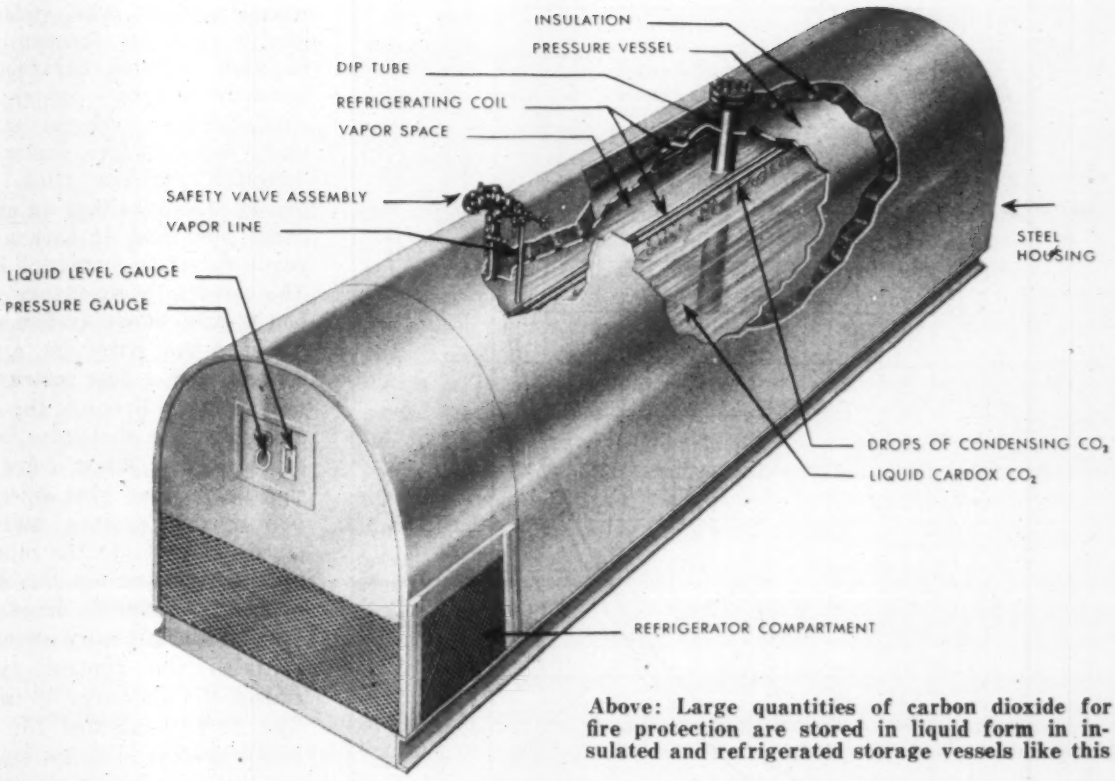
Less stringent requirements prevail for the piping between the master valve and the selector valve. Since this section of pipe is only under pressure during a discharge, the lighter weight 300 lb malleable black fittings may be used and threaded connections need not be welded. Absolute tightness of connections is not essential; nevertheless, there must be no visible or audible leaks.

The piping downstream of the selector valve, also under pressure only during discharges, but at a lower pressure than the previous piping section, permits the use of standard weight pipe. However, it must be galvanized, since this last piping section is open to the atmosphere at the nozzle end and therefore subject to interior corrosion.

Good, acceptable piping naturally demands secure support and anchoring. Specific types of supports can be selected from a large choice of designs, but to ensure safety, only clevis hangers, strap hangers, wall brackets, wall clamps, trapeze hangers, etc., made of steel are permissible. Cast iron supports or conduit clamps are not considered satisfactory. Generally spacing supports at 10 ft intervals is adequate, although for ¾ in. pipe and smaller, 6 to 8 ft spacing is necessary to prevent sagging. Solid anchoring to walls, ceilings, or columns by angle iron bracing near discharge nozzles serves to counteract the discharge reaction which might otherwise set the pipe swaying.

Considerable Pipe Contraction

Cooling of the piping during a discharge results in considerable contraction and therefore the construction must allow for longitudinal movement of the pipe. The temperature of the pipe may range from 0 F near the storage tank to about —50 F at the nozzle end of the system. Self-refrigeration of the carbon dioxide is responsible for this progressively decreasing temperature along the length of the pipe. This phenomenon, common to all liquids if they are caused to flow from a vessel at saturation pressure, is particularly noticeable in carbon dioxide flow because of the large pressure drop experienced. It is a law of nature that for every given pressure, the liquid must invariably assume a definite corresponding temperature. Thus, lowering of the pressure induced by the flow through the pipe brings about a temperature drop from 0 F to —50 F as the pressure changes from 300 psi gage in the storage tank to, say, 100 psi gage at the nozzle. To produce this cooling effect, some of the liquid must vaporize—in fact, at the nozzle, about 18 per cent of the carbon dioxide



Above: Large quantities of carbon dioxide for fire protection are stored in liquid form in insulated and refrigerated storage vessels like this

by weight is in vapor form. In terms of volume, this represents a very considerable change. Since the specific volume of the vapor at 100 psi gage is much greater than that of the liquid, the volume of the carbon dioxide liquid-vapor mixture at the nozzle is about nine times the volume of the liquid in the storage tank, as shown in the accompanying graph.

The extent of pipe contraction experienced as a result of cooling is about the same as the degree of expansion accompanying the flow of low pressure steam. The shrinkage of 100 ft of steel pipe due to temperature drop from, say, 80 F to the minimum of —50 F amounts to about 1 in. Taking up this contraction requires a joint that permits pipe movement. Such a joint is necessary between two points of rigid anchorage and at approximately every 100 ft of pipe in long lengths of straight run. Often, as a part of the natural layout of the system, a swing joint can serve to give the desired flexibility. A joint of this kind occurs when a short vertical as well as a horizontal pipe section must be used as a connection between two straight runs of pipe going in the same direction but on different planes. Lacking such a convenience, either a U section or a slip expansion joint is employed.

Because of the pipe movement due to contraction, it is evident that a pipe rigidly set into a wall or partition through which it must pass might break the bond and produce undesirable cracks. This difficulty is overcome by leading the pipe through a sleeve. A suitable sleeve is one made of standard black steel pipe of at least two pipe sizes larger than the pipe passing through it, with the annular space packed with oakum or asphalt compound. Face plates are sometimes used for trim. Sleeves through floor or roof slabs are generally extended several inches beyond the floor or roof level in accordance with local building regulations.

At times it is necessary or desirable to embed the pipe in a concrete floor or wall or to run it underground. In such a case, extra heavy steel piping is always used and all connections are welded. Wrapping the pipe with burlap provides for contraction when it is encased in a concrete slab. For underground piping, a double, spirally wound, burlap wrapping with intermediate and final treatment of corrosion resisting pipe coating is considered essential to guard against deterioration. Normal depth below ground level is either 3 ft or below the frost line.

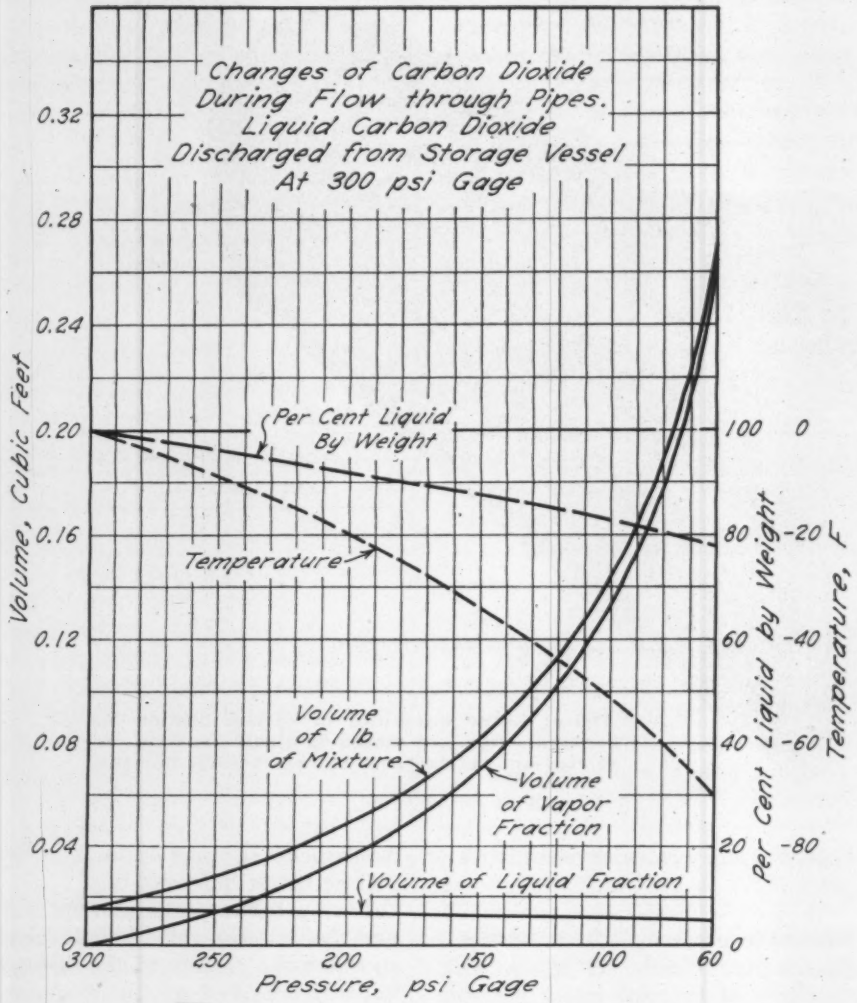
Piping between the storage unit and the selector valve should slope so that upon closing of the selector valve at the end of the discharge the liquid remaining in this piping section can drain back into the tank. At the end of the discharge the master valve also closes, but it is purposely constructed to permit return flow from the piping into the tank when the inflow of heat raises the pressure of the piping system above the tank pressure.

Should it be necessary to run part of this piping at a level below the top of the storage unit, then a return of substantially all liquid in the piping is accomplished by placing a "U" trap at the bottom of the riser nearest the tank.

After all liquid has returned to the tank, further heat flow into the piping also forces the return of some vapor which the refrigerator recondenses into its original liquid form.

Control Piping

The auxiliary manual pilot system, always provided, backs up the electrical control system so that the valves can be operated even in the event of a possible current failure. This system involves a normally



energized valve which, upon interruption in electrical service, admits carbon dioxide vapor pressure to open the master valve. Should a discharge then be required, an operator need merely turn a conveniently located hand operated pilot valve to open the proper selector valve. The general arrangement of this control system is shown in one of the diagrams. Standard galvanized pipe of ½ in. and ¼ in. size is used for pilot piping, except for the piping section continuously under pressure which requires extra heavy pipe with back welded connections.

Another auxiliary piping system frequently used serves to close windows, doors, and other openings in case of fire. Closing of openings accomplishes several purposes. It shuts off the fresh air supply which inhibits the severity and spread of the fire. It assures efficient use of the carbon dioxide injected into the space and it retards dissipation of the carbon dioxide after the discharge, thus allowing an extended soaking period, to be certain that all materials have cooled below the ignition point of the inflammable vapors. If openings are not closed, fires can be effectively extinguished nevertheless, but the rate of carbon dioxide application may have to be greater and consequently a larger storage tank, larger piping, and larger valves are required. To provide automatic closing of windows, doors, and the like, they are hooked to a pressure operated release device. A piston in this device pushes forward when carbon dioxide vapor under pressure is admitted to the piping and forcibly disengages the hook. The properly weighted doors or windows then close by gravity. To direct the operating pressure to these releases, ½ in. standard galvanized pipe is used, together with extra heavy galvanized malleable fittings.

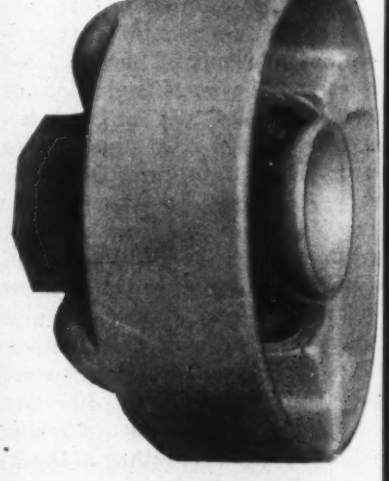
In locations such as pipe tunnels connecting test cells, violently explosive mixtures frequently exist. In such extreme hazardous locations or in rooms in which dangerous gases such as ether are likely to be set free, explosionproof detection systems must be employed. Hence, either an explosionproof electrical or carbon dioxide vapor detection system is installed. The essential components of a carbon dioxide vapor system are fusible head heat detectors, a pressure control, and a flow restricting orifice, as shown in one of the sketches. Normally, the whole pipe line is under pressure. When a fire releases the fusible head heat detector, carbon dioxide escapes rapidly and, since its flow into the pipe is very much restricted by the upstream orifice, the pressure drops, thus actuating the pressure switch which initiates the control cycle and causes the discharge to take place. The piping specified for this detector system is ½ in. extra heavy black pipe with steel fittings and back welded joints, because it is continuously under pressure.

Piping Installation and Testing

As can be readily appreciated, one of the most important concerns is to be assured that all piping connections and valves are tight. Thus, particular care is taken in assembling the system on the job and then tests are made to verify the condition of the completed system.

Preliminary to assembly, all screwed piping and fittings are inspected to see that the threads are clean cut and full length and that

Total flooding discharge nozzle



the ends have been reamed free of burrs and ridges. Then the pipe is thoroughly cleaned by pulling a wire flue brush through it several times and following it up with a bundle of clean rags soaked in carbon tetrachloride. In the case of welded pipe, this treatment is preceded by pounding the joints to loosen the scale. As a further precaution, dirt and blowout pockets are installed beyond the last take-off of each main header or in headers at 90 deg turns when the run back of this point is about 75 ft or more. Such pockets are preferably about 18 in. long but, in cramped quarters, short 3 in. nipples with caps have sometimes been used.

To permit pressure testing of valves after installation and also to facilitate subsequent removal or replacement, a short removable section of pipe is generally located directly downstream of the valve.

After the piping is in place, it is inspected for possible leakage. The test pressure is 300 psi, using carbon dioxide vapor or air. Not the slightest leakage is permitted in the piping section between the storage tank and the master valve, which is continuously under pressure. Also, the master valve must be found to shut off absolutely tight. With the careful application of soap solution, the degree of tightness is readily determined. The testing of the tightness of the valve on the job would seem to be superfluous in view of the fact that all valves are individually tested by immersion in a kerosene bath before shipment; however, this double check serves to give extra assurance of unquestioned reliability. All piping downstream of the master valve must, of course, also be tight, but since this portion of the piping system is subject to pressure only during a discharge, absolute bubble tightness is not required. Piping which is to be permanently concealed must show no leaks whatever. Such piping sections must be pressure tested before being covered.

REFRIGERATION FOR AIR CONDITIONING AIRCRAFT

Of late there has been considerable discussion of heating and ventilating airplanes with emphasis on heating requirements and the various types of heating systems. A good deal of consideration has also been given to minimum ventilation requirements for the dissipation of odors, tobacco smoke, etc. The ventilation rate, of course, has a direct effect on the humidity problem, which is of importance particularly on long range, high altitude flights throughout the year.

In a paper, Refrigeration for Air Conditioning Aircraft, which was presented at the National Air Transport session of the SAE, December 5, 1945, the author, Bernard L. Messinger, states that "it is a common misconception even among engineers that aircraft air conditioning does not require refrigeration simply because airplanes can be flown at sufficiently high altitudes to avoid excessive ambient temperatures." To support his statement that refrigeration is necessary, the author, who is associated with the Lockheed Aircraft Corporation, points out that on a hot summer day a 75 F temperature is not reached until a plane has reached an altitude of 7000 ft. Due to solar radiation, internal heat dissipation, and the difference between static and total temperature—the rise in temperature due to stopping air (relative to the plane) having an initial velocity equal to the free air stream—the actual cabin temperature will be 85-95 F. Another factor which is stressed is the elapsed time between the terminal and point of take-off. In some cases the time amounts to 30 minutes or more. In airplanes having pressurized cabins (especially where pressurization begins at take-off) the need for refrigeration is augmented due to reduced ventilation within the practical limitations of the superchargers and the fact that even with aftercoolers, the air delivered to the cabin is of somewhat higher temperature than the total ambient temperature.

After describing design conditions which were used for the Lockheed Constellation, the author compares the vapor refrigeration cycle, the use of dry ice, and the air expansion turbine system. In spite of the fact that the vapor compression system is by far more efficient than the latter, he does not consider it the first choice for this use because a "Freon 12" system designed for a plane having 60 persons would require about 10 tons capacity with a 17 hp motor for the compressor and a 5 hp motor for the condenser fan and the total weight would be about 58.5 lb per ton.

The use of dry ice, which would liberate large volumes of CO_2 during pressurized operation, would require an indirect system. Such a system was set up with an alcohol circulating system involving a circulating pump, a modulating by-pass control valve, storage tanks for dry ice, etc. This system is not considered desirable because on a cross country flight, even after half the distance was covered, the total weight would be about 88 lb per ton. From the standpoint of ease of maintenance the system leaves much to be desired and there is the additional problem of handling the dry ice while charging the storage tank.

The air refrigeration cycle, which is rarely used in the commercial field because of its relative low efficiency, was selected as the most practical choice for the Constellation. Power enters the system only through the cabin superchargers, which are no larger than would be required for pressurization alone. This is due to the fact that they are designed for high altitude flight and at sea level they have the inherent capacity to supply the mass-flow required for the maximum refrigeration. In this system air enters the pressurizing compressors, passes through a primary intercooler, a secondary compressor, an aftercooler, an air turbine, a water separator, and finally to the cabin in the order named. The air turbine is used to drive the secondary compressor and the fan which supplies the coolant, air, to the aftercooler. It also reduces the pressure of compressed air to approximately atmospheric pressure. The total weight of the installation is about 25 lb per ton of capacity and it is arranged for ready accessibility. According to the author, this system is considered to be the "simplest, lightest, and most compact system for the purpose of conditioning pressurized transport airplanes."

The telephone building in St. Louis during cleaning operations. The company believes it will take three or four times as long for the building to return to its condition prior to this 1941 cleaning, now that the city smoke has been greatly reduced.

Does SMOKE ABATEMENT Pay?

Business and Professional Men of St. Louis Say "Yes," According to Smoke Commissioner J. H. Carter

THE QUESTION of reducing the smoke in the atmosphere of our American cities is receiving more attention and publicity now than ever before. Articles on the subject are appearing in magazines and other publications—not only the technical press, but those having general circulation as well. From the Mississippi valley to the eastern seaboard almost every larger city having a concentration of industry, or a winter season requiring heating, is now either enforcing a smoke abatement program or actively promoting one. Some, which have had smoke regulating ordinances on their books for many years, are now considering making them more severe and more effective. Scarcely a day passes that the daily press of some part of this area does not carry a story or an editorial urging action along this line.

Yet effective smoke reduction cannot be accomplished without some impact on the citizens of the community. The average householder finds that he must radically change his fuel burning habits. He has to learn more about firing a furnace than he ever knew before, and be vigilant in putting his newfound knowledge into day by day practice. He may be required to spend money for less smoky fuel or improved heating equipment. He must, in any case, become conscious of smoke, not only as he sees and smells it in the air, but as it comes from his own chimney.

If he operates a piece of rental property or a place of business he has these additional heating plants to keep smokeless. Perhaps he owns a factory with a boiler room in connection. Here he has a still greater problem. These industrial power plants are apt to be among the worst smoke offenders. Complete revamping of the fuel burning equipment may be necessary. The laundries, bakeries, railroads, and countless other industries of the city find themselves with an added factor in the operation of their businesses which must receive and hold their constant attention.

Is the Trouble Worth It?

Smoke abatement, like any other civic improvement, cannot be brought about without cost to the taxpayer. In the case of smoke abatement, is it worth it? Does the average citizen derive enough benefit from a cleaner atmosphere to pay him for his part in the necessary effort? Does the city as a whole gain anywhere except in the air? These and other similar questions are bound to be asked when smoke abatement is discussed. The answer to them can be found only in a city which once existed each winter under a blanket of "smog" but finally arose and did something effective about it. Such a city is St. Louis.

The St. Louis smoke ordinance was passed by the board of aldermen and put into operation in April, 1940. It was called a "drastic" or-

dinance because it prohibited the burning of high volatile (smoky) coal, except in mechanical stokers, in the city. It even made illegal the sale of such coal except in stoker sizes. Although bitterly attacked, it was fully enforced its first year and each succeeding year, notwithstanding that enforcement was made more difficult as the war progressed.

The local office of the Weather Bureau is located in downtown St. Louis. Its observations, therefore, record conditions as experienced in that part of the city most affected by smog—the business area. Hourly recordings of smoke in the atmosphere are made as a part of the Bureau's routine. Fortunately, these records are available for the last winter before the new ordinance was passed and for each of the five subsequent winters. They show that the average overall reduction in smoke has amounted to 73.1 per cent, with the biggest gain being in "thick" smoke, where the reduction has been 80.8 per cent.

To remove nearly three-quarters of the winter's smoke from a city's atmosphere must have wrought some noteworthy changes in the living conditions of its citizens. Down what avenues shall we look to find them?

Smoke Cost $14 Million a Year

Back in the days when the city groped its way each winter through a cloud of smog, the Citizens' Smoke Abatement League prepared a report showing how much it was costing the people of St. Louis to support its smoke nuisance.* This report took into account the added laundry, dry cleaning and redecorating bills, the loss due to deterioration of sheet metal and other exterior surfaces, the loss of merchandise on shop shelves, the extra cost of artificial lighting, etc. Not including the cost of wasted fuel, they found that the detrimental effects of the smoke laden atmosphere alone cost the people of the city over 14 million dollars a year.

To determine whether or not some of these millions are being returned to the city's residents as dividends on their investment in smoke abatement requires the contacting of people who can supply facts rather than opinions. Visitors who come to St. Louis to study its smoke program learn much of interest from the "man on the street." The taxi driver, the police officer on the corner, the newsboy, the housewife, the shopkeeper can all tell us that they like smoke abatement—that they "wouldn't go back to the old days for anything"—but they are not in a position to give facts or figures. Our information must be obtained from those whose everyday business deals with one or more of these items. Let us see what some of them have to say.

The most conclusive way to obtain the information would be in the form of dollars-and-cents comparisons of costs before and after smoke regulation. Unfortunately, this is possible only in a few cases. All but one of the years since the ordinance's enactment were war years. Material and labor costs are no longer comparable. It was discovered, for instance, that whereas the work required to keep clean a square foot of rental space in a downtown office building is less, the dollar cost of that service has increased.

Nor can all the benefits of a clean atmosphere be measured in dollars and cents. How can we evaluate the ability to beautify our parks and boulevards with plants and shrubbery? What is the gain to the pocket books of property owners through the landscaping of their homes and estates? Yet here we find one of the most striking evidences of what happens when smoke is greatly reduced. It is found that flowering plants, shrubs, and trees thrive—where, before, they wilted and died or at best were not able to attain full beauty.

Beneficial Effect on Plant Life

The Missouri Botanical Garden, which—popularly known as Shaw's Garden—has been one of the showplaces of St. Louis since our grandfathers' time, has had much to say about the effects of smoke in the air in its publications of past years.† Such plants as begonias, cinerarias, tropical water lilies, fuchsias, etc., might be entirely defoliated during a single smoke pall of less than 24 hr duration. Other plants, which might not lose their leaves, would have them discolored. But these were only the instantaneous effects. Latent effects showed up over a period of time in abnormal browning and dropping of leaves, drooping, or discoloration of flowers.

By the time the ordinance had been in operation only a few months, the beneficial effects on plant life were so noticeable that the garden devoted a considerable portion of its January, 1941, bulletin to a discussion of them. So far, they said, neither the latent effects nor the sudden "overnight" damage had been observed in any of the plants previously known to be particularly sensitive to smoke. "Certainly," they said (in 1941) "there has been such a marked improvement that one is inclined to become optimistic about the possi-

IT IS FITTING to follow up Raymond R. Tucker's series of five articles on the details of the St. Louis smoke elimination program—which was concluded in the February 1946 Heating, Piping & Air Conditioning—with an answer to the question, "Does smoke abatement pay?" J. H. Carter, smoke regulation commissioner of St. Louis, reports here an emphatic "Yes" as the answer based on opinion, facts, and figures from business and professional men of that city. Clearing three-quarters of the smoke from the city's atmosphere has—he states—made for a more beautiful city, improved the health of the residents, lowered housekeeping costs, and increased business profits. . . . There are many cities now giving increased attention to this matter, many others that should be. This article on the results of an outstanding program, and Professor Tucker's five articles on its details, are of great value and importance

*Annual Cost of Smoke Nuisance to St. Louis, Speakers Bulletin No. 13, Citizens Smoke Abatement League, 1927.

†Missouri Botanical Garden Bulletin—Vol. 5, No. 11; Vol. 12, No. 6; Vol. 12, No. 10; Vol. 16, No. 1; Vol. 20, No. 2.

bilities for successful gardening in the city."

Five years later, Dr. George T. Moore, the garden's director, affirms that the optimism was justified. Asked for a further statement, he said he could do no better than corroborate what was said in January, 1941. The city floriculturist, also, states that the same results have been observed in the city's parks and greenhouses, and the city forester adds, "Now we feel safe in planting evergreens and even juniper in our downtown area. Previous to the adoption of the city smoke ordinance, this was unthinkable."

It appears quite evident that, apart from a cleaner and brighter sky, a relatively smoke-free city can be a more lovely city to live in than a smoky one. If the professional growers find conditions so much more beneficial to plant life, this must be true of every homeowner who tries to maintain a velvety lawn and a few flowers or shrubs to reflect his pride in his own place! The more amateur a gardener he is, the more he needs all the help nature can give him. Smoke reduction gives nature a chance.

Is Health Affected?

We are inclined to think that atmospheric conditions which benefit plant life should also benefit human life. The question as to whether or not smoke in the air is detrimental to health has been argued pro and con for many years. However, we are not interested in these arguments now, we want only facts in the form of results. Has the removal of 73 per cent of the smoke from the atmosphere had any effect on the health of the people of St. Louis?

Marked improvement cannot be looked for in those diseases which are reported to the Bureau of Vital Statistics; hence, it was necessary to put this question individually to the eye, ear, nose, and throat doctors of the city. Their response was immediate and most conclusive. Of the 33 nose and throat specialists who replied, only four could say they had seen no improvement. The other 29 are almost unanimously agreed that "there has been a very definite reduction in infections of the upper respiratory passages and of the tracheobronchial tree." Since smoke regulation (they say) they have observed considerable changes in the mucous membranes of the nasal passages. "Nowadays we rarely see a nasal mucosa spotted with soot particles as we used to see them," is the way one put it. Prolonged and repeated exposure to the old soot-laden air of St. Louis caused serious and permanent damage to the delicate membranes of nose, sinuses, and the lungs, these doctors told us. Such injuries rendered the membranes more susceptible to infection, with resultant increases in colds, sore throat, sinus infection, influenza, laryngitis, bronchitis, pneumonia, etc. In the opinion of nearly everyone, a great decrease in the irritating effects of the city's air has been brought about. A reduction in the incidence of these diseases has therefore inevitably been accomplished, and cases which are brought to the doctors respond much more readily to treatment.

Are you a sufferer with hayfever or asthma? If so, move to a less smoky city. Smoke regulation has been a tremendous benefit to these patients, we are told, as smoke and gas cause a marked aggravation of the symptoms. Most of the sinus trouble, too, is aggravated by breathing smoky air. "Patients with a chronic sinus disease generally have felt better due to smoke elimination" is the testimony.

As indicative of what the experience of the majority of the nose and throat specialists in St. Louis has been, the following letter from one of them is quoted.

> "For almost 30 years, 90 per cent of my practice here in the city of St. Louis has been confined to the diseases of the upper respiratory tract and the paranasal sinuses. During these years, up to several years ago, I have noted the effect of our polluted air upon these organs, and the frequent, if not almost continuous, suffering from head colds with the consequent involvement of the sinuses, the burning throats, the harsh, dry coughs, in many cases terminating in some form of lung or bronchial complication. I have observed the effect of sulphuric acid fumes upon those either sensitive or allergic to them. I have also witnessed the pitiful fight for air among those afflicted with any type of asthma. It has been a distinct pleasure to note the beneficial effect on these respiratory organs now that the air pollution has been more or less controlled. I have no way of estimating the number who have been benefited by the smoke elimination program, but I feel certain the number is quite large."

The eye specialists, while not quite as unanimous as the nose and throat doctors, are sufficiently so to leave no doubt that smoke abatement has reduced the number of eye infections and has alleviated the suffering of those afflicted. This is particularly noticeable in cases of conjunctivitis which are secondary to nasal irritation, but also in inflammation and irritation of the external eye caused by "irritants, both chemical and mechanical" in the air. The following quotation from one of the letters tells the story quite concisely and to the point.

> "I desire to state that there has been a very noticeable improvement in the incidence of eye infections since the smoke program has been adopted. I hope there will never be any relaxation in the law now in force as eye infections, due to smoke pollution, *have almost been eliminated.*"

So we find accrued dividends due to smoke reduction in the form of a more beautiful city and a more healthy city. Nor are these entirely "stock dividends." The testimony of the medical profession shows that its benefits are paying out in cash. Fewer trips to the doctor's office can't help but mean lower doctor bills!

Building Renovation and Repair

Civic beauty, too, can be closely related to the pocketbooks of all property owners. This becomes apparent when we consider the maintenance of the exterior of our buildings, both as to renovation and repair. Atmospheric smoke and soot not only soil but stain nearly all external surfaces. The accompanying airborne acids attack and eventually destroy paint and sheet metal. The Citizens' Smoke Abatement League, in the survey previously mentioned, found that the people of St. Louis were paying out over $2½ million a year just for unnecessary renewing of paint and sheet metal. Is some of this money being saved?

The destructive effects of smoke on these materials, particularly the chemical actions, require time. Five years is hardly a long enough period in which to observe results quantitatively. This is true even as to its effect on paint when we con-

sider that they were war years during which work in this line was greatly curtailed. And what work was done was with "wartime quality" paint, which — the painters frankly stated—was not up to the standard.

However, they are not without evidence of beneficial results. Their observations sum up about as follows: Surfaces are easier to prepare as they do not carry the former coating of soot and grime. Many paint jobs can now be done in one coat that formerly required two. And last, and right to the point, "we also find that the wearing qualities of paint, particularly on the exterior of buildings, has been increased at least 25 per cent." Twenty-five per cent of the money the league found was being needlessly spent for outside painting will come to over a quarter of a million dollars a year—a tidy sum to put back into the pockets of a city's property holders.

The sheet metal artisans are no less positive. These men could rely on their experience of many years past. Not all of their work was within the city limits. Much of it was done out in the county—in the suburbs—where so many St. Louis taxpayers migrated to escape the city's smoke and dirt. Their experience, we are told, was that they expected architectural sheet metal to last three times as long out there as it did in town. Already, since the smoke regulation, they have noticed an improvement in the condition of metal roofs, gutters, cornices, valleys, and other work in the city. Particularly they do not find these surfaces "covered by soot like we did before 1940. This lack of soot," they say, "will help all outside sheet metal to last longer and also require less frequent painting."

One evidence of a renewal of civic pride brought about by the reduction of smoke, which has been apparent even to the man on the street, is the marked increase in the number of buildings which had their exteriors cleaned. Downtown St. Louis, particularly, has benefited by the restoration of many monumental structures to their original architectural beauty. In the residential districts as well, one has noted many apartments, and even small brick homes, cleaned by washing with water or chemicals. The contractors who do this work are loud in their praise of smoke abatement because it has brought them more business. Said one, "We are of the opinion that most of this increase is due to the fact that the public is convinced that the smoke regulations are permanent." But they also say about their work as it affects the pocketbooks of the men who pay the bills, "Today, these people realize that if their buildings are cleaned they will stay that way for some time and it is a good investment for them to have this work done."

The building housing the offices of the Southwestern Bell Telephone Co. is pointed to as one of the notable examples of exterior renovation undertaken since the smoke ordinance. It is one of the largest structures in the city. The contract for its cleaning was the biggest ever let for a single building in St. Louis, and the work was the most extensive ever attempted anywhere with the particular process used. It was completed during the summer of 1941, a little over a year after the ordinance was passed. Officials of the Bell company say the fact that St. Louis had an effective smoke regulation program was a leading factor in their decision to have the work done. Four years later, the company said, "While we don't know the exact time it would take for the external surface of the building to return to the condition it was in prior to the 1941 cleaning, a 'horseback appraisal' might be that it would take three or four times as long."

Interior Decorating and Cleaning

Cleaning the outside of buildings may be of only passing interest to many a city's residents, but keeping the insides clean is of first hand importance to nearly everyone. It is in this connection that the effects of smoke reduction first make themselves obvious to the people as a whole. There is the evidence of countless housewives that their curtains do not have to be rewashed so soon, and that their draperies go less often to the cleaners. Homeowners and paperhangers say that wallpaper needs less frequent renewing and that it is more easily cleaned on the wall. Professional housecleaners and those who specialize in the renovating of interior furnishings are almost unanimous in agreeing that they find less dirt and have less trouble removing what is present. One rug dealer ruefully remarked, "it is not very good for my cleaning department."

Hotels Save Many Thousand Dollars

Those people with whom housekeeping is a business are unstinting in their acclaim of the smoke regulation program. Letters from some of them wax almost rhapsodic. The owner of six large apartment buildings writes, "We clean our apartments once each year—the walls are about 50 per cent cleaner at the time of cleaning than they were prior to the passage of the smoke ordinance." Says another (who operates several large furnished apartments and hotels), "A dollars-and-cents comparison cannot be made of before and during smoke control. However, the general reduction in the expense (housecleaning) is so marked that we believe the major credit is due to effective smoke control." This is what the manager of a good sized housing project says of his housecleaning bills, "I cannot give you a dollars-and-cents reply, but no doubt we have saved a great deal of money." He has 252 apartments; if he has saved "a great deal of money" there can be also no doubt that the people of St. Louis have saved a great deal more. "The smoke ordinance has undoubtedly saved householders many thousands of dollars in furnishings," one upholstery man tells us.

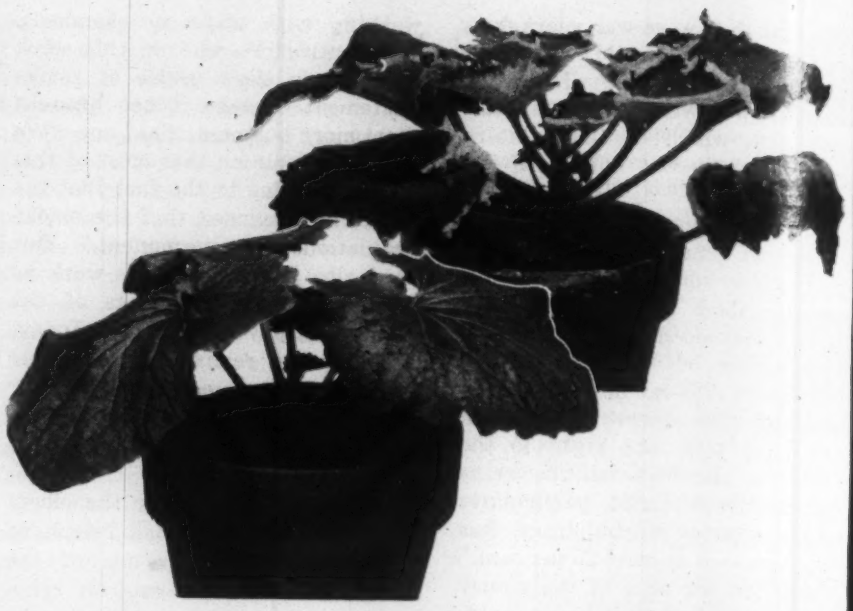
"A great deal of money" . . . . "Many thousands of dollars." These are impressive, but we still need a concrete idea as to how much they might amount to. The answer comes from the Hotel Association of St. Louis. Twenty-one of the city's large hotels took part in this survey. They say, "Considerable time and thought were given by the hotels. . . . in estimating the savings and benefits derived by them as a result of your program, and we feel that the savings in cost in cleaning, in decorating, and other items were approximately $153,880." Is there any doubt that the investment these hotels made in smoke abatement was good business?

The Building Owners' and Managers' Association of St. Louis numbers among its members most of the large downtown office buildings. We asked them about their cleaning and decorating costs—they replied with a whole string of credit entries. "There is no doubt that office buildings have benefited," they say, "in the way of eliminating smoke from stacks of lower buildings pouring into offices of adjoining buildings; reduced decorating costs; length of time for washing outside of buildings increased; decrease of soot deposits on desks and chairs during working hours of tenants; corridors and lobbies easier to keep clean during moisture precipitations, such as snow and rain; uniforms remain clean longer; complaints to manager's office in regard to cleaning and dirt reduced."

Reduces Spoilage in Stores

Most of the above listed benefits will also be felt by the department stores and smaller retail establishments. The greatest loss suffered by them because of smoke, however, was due to the spoilage of merchandise displayed for sale on shelves and counters. The growing use of air conditioning is lessening this evil to a great extent, but even in the larger stores where conditioning is more widely employed, the effects of smoke reduction have been noted. One evidence is in the smaller amount of soot found on the air conditioning filters. This is the testimony of the Associated Retailers of St. Louis, comprised, in part, of the large department stores. This group adds that their dry cleaning plants, installed in the old days to clean sooty and soiled merchandise, now are almost entirely engaged in cleaning the personal apparel of their employees, "while the renovating of garments and textile merchandise has fallen to an alltime low." With regard to shelf loss, they conclude that "there has been much improvement since our smoke elimination campaign has been put into effect."

The proprietors of the smaller shops in the downtown area and outlying shopping districts are even more loud in their praise. "There has been a marked difference in the last few years in the soiling of merchandise."..."Our display rooms are cleaner and merchandise free from excess dust"...."We notice our open shelves containing fabric samples stay very much cleaner." It is understandable that they are not able to translate these findings into dollars and cents. Though difficult to measure, the savings are nonetheless welcome.



Cineraria plants at the Missouri Botanical Garden after and before smoke regulation. One of the showplaces of St. Louis for many years, Shaw's Garden —as it is popularly known—has had much to say about the effects of smoke in the air in its publications of past years. "Certainly, there has been such a marked improvement that one is inclined to become optimistic about the possibilities for successful gardening in the city," it was stated in 1941, and the director recently affirmed that this optimism about city smoke was justified.

Electricity Saved

In an article in one of the daily papers in another city, it was stated that the people of St. Louis were saving $35,000 a year in electric light bills because of the smoke ordinance. No one knows where the reporter who wrote the story obtained that figure, unless he reached for it out of thin air. If so, he did not reach far enough. The Union Electric Co., which supplies St. Louis with electricity, says it is over twice that amount. To arrive at such an estimate, they had to consider not only the fewer smoky hours but such factors as the normal increase in the consumption of electrical energy by the public, the effects of clouds and overcast skies, the increase in population, wartime three-shift opertions, etc. With all of these taken into account, the electric company estimates that the people of St. Louis are saving about $75,000 a year in decreased light bills because of the reduction in atmospheric smoke.

These are the testimonials of business and professional men of St. Louis who have had the opportunity to observe the impact of five years of smoke abatement upon the people of the city reflected in their own businesses. They tell us experience shows that eliminating three-quarters of the smoke from the atmosphere has very definitely accomplished these results. It has made for a more beautiful city, improved the health of the residents, lowered housekeeping costs, and increased business profits.

To the question, "Does smoke abatement pay?" St. Louis answers a most emphatic "Yes!"

Consulting Engineers — The Chicago Association of Consulting Engineers marked recently its silver anniversary, and elected Oscar W. Dauber, president; Le Roy H. Nettnin, vice-president; and Norman E. Bueter, secretary-treasurer. Mr. Bueter, of Holabird & Root, gave a talk on air conditioning, and John Aeberly, chief of the city bureau of heating, ventilating, and industrial sanitation, spoke on ventilation code requirements.

Pipe Specifications, Insulation Standards Developed by ASTM's Technical Committees

Many Important Developments During Committee Week

MANY important developments in the work on standards and research in materials were discussed and acted on at the some 200 meetings of technical committees of the American Society for Testing Materials, held in Pittsburgh during committee week extending from February 25 through March 1. As a result of the discussions a large number of new tentative specifications and tests will be referred to the society, and many of the committees have important changes to make in existing specifications; also a number of new research programs were planned.

The meetings of committee A-1 on steel were featured by rather intensive activity in the fields of structural steel, bar steels (both carbon and alloy), and pipe and tubing. Numerous recommendations in other fields covered spring wire, forgings, steel castings, and steel for boilers and pressure vessels. To meet the expressed need for guidance in establishing not only specific requirements but tests for materials used at extremely low temperatures, two subcommittees covering boiler and pressure vessel steel and pipe and tubing have appointed special sections to develop information and data.

A notable recommendation approved in the field of steel pipe and tubing was the withdrawal of virtually all of the emergency alternate provisions which had been introduced not only in the interest of conservation of critical alloying elements, but also to expedite production. The committee in charge felt it best to canvass those concerned with production and use before proceeding too rapidly, but now is revising numerous pipe and tubing requirements, in many cases to prewar chemical and physical requirements, although in several cases it is incorporating a number of practices which were set up as emergencies.

In 13 pipe specifications, a set of formulas will be incorporated covering the elongation requirement for strip tests where specimens are cut from material less than 5/16 in. in thickness. In certain of the tube standards covering steel, the values for permissible manganese are being raised.

A survey indicated that three specifications previously issued through joint work with committee A-10 on iron-chromium, iron-chromium-nickel and related alloys, covering various types of ferritic and austenitic stainless steel tubing for general service, and for the dairy and food industry (A 268, A 269, A 270) are widely used, but a companion specification, A 271, covering still tubes, is apparently not in general use. Reasons for this are to be studied in an effort to insure that the benefits from the standardization program on still tubes may become more widely effective.

Committee C-16, on thermal insulating materials, has many projects under way, including a study of the impact test and the measurement of deflection during flexure and at the breaking point of preformed block and pipe insulation.

The committee has completed a new method of test for strength of insulating board made from vegetable fibers. This method was submitted for publication this year.

Specifications for blanket or bat thermal insulation for building purposes are under consideration. The committee is studying and obtaining data on water and moisture vapor transmission and also on fire and flame resistance in order to establish the specific requirements for these properties.

In work on physical properties of loose fill insulation made from both mineral and vegetable materials, a study is being made by producers and consumers to determine the physical properties applicable to this type of insulation and following this the data will be evaluated for use in the establishment of specifications.

The group on thermal conductivity of all forms of insulation — which functions under the sponsorship of the ASTM, ASHVE, ASRE, and NRC—has selected three methods of test for determination of conductivity of pipe insulation. Check tests will be conducted by various members and results reported at the next meeting. These data will also serve as the basis for the development of a standard pipe conductometer.

The subcommittee on measurement of thermal properties other than thermal conductivity has under consideration the following properties of thermal insulation: (1) heat capacity or volumetric specific heat, (2) thermal diffusivity, coefficient of thermal conductance, (3) effect of prolonged heating at high temperatures, (4) heat (dimensional) stability at high temperatures, (5) surface emissivity (radiation).

A special committee is being appointed to study the application of a rational dimensional standard for use by the 85 per cent magnesia industry. At the present time, some seven manufacturers on thermal insulation have adopted the rationalized dimensional standard.

Another important problem concerns studies of vapor barriers applied to thermal insulation used especially in the air conditioning and refrigeration fields where the group in charge has under consideration a draft of a test method. Check tests are now being conducted for water vapor permeability of sheet materials. It is hoped that a tentative method will be completed at the next meeting of the committee.

A Simplified Procedure for

SPECIFICATION WRITING

By George W. Campbell

THE SPECIFICATION-WRITING procedure outlined in this article was devised and used by the author while in the service of Thomas H. Urdahl, consulting engineer of Washington, D. C., prior to his entry into the armed forces in June 1941. While some of the examples may be outdated, the principles outlined are still valid.

The method previously used was satisfactory where all personnel were well trained in their duties, but with the rapid turnover in personnel, errors habitually crept into specifications. In order to eliminate these errors, to increase the flexibility in the preparation of specifications, and to make it possible to use semi-skilled clerks, the method described here was inaugurated.

In order to use standard size paper and filing cabinets, a 5 in. by 8 in. card was selected. One set of specifications was made on cards, and the working copies were made on plain paper and mimeographed. Regular 5 in. by 8 in. index cards are used to divide the various specifications.

The Master Specifications

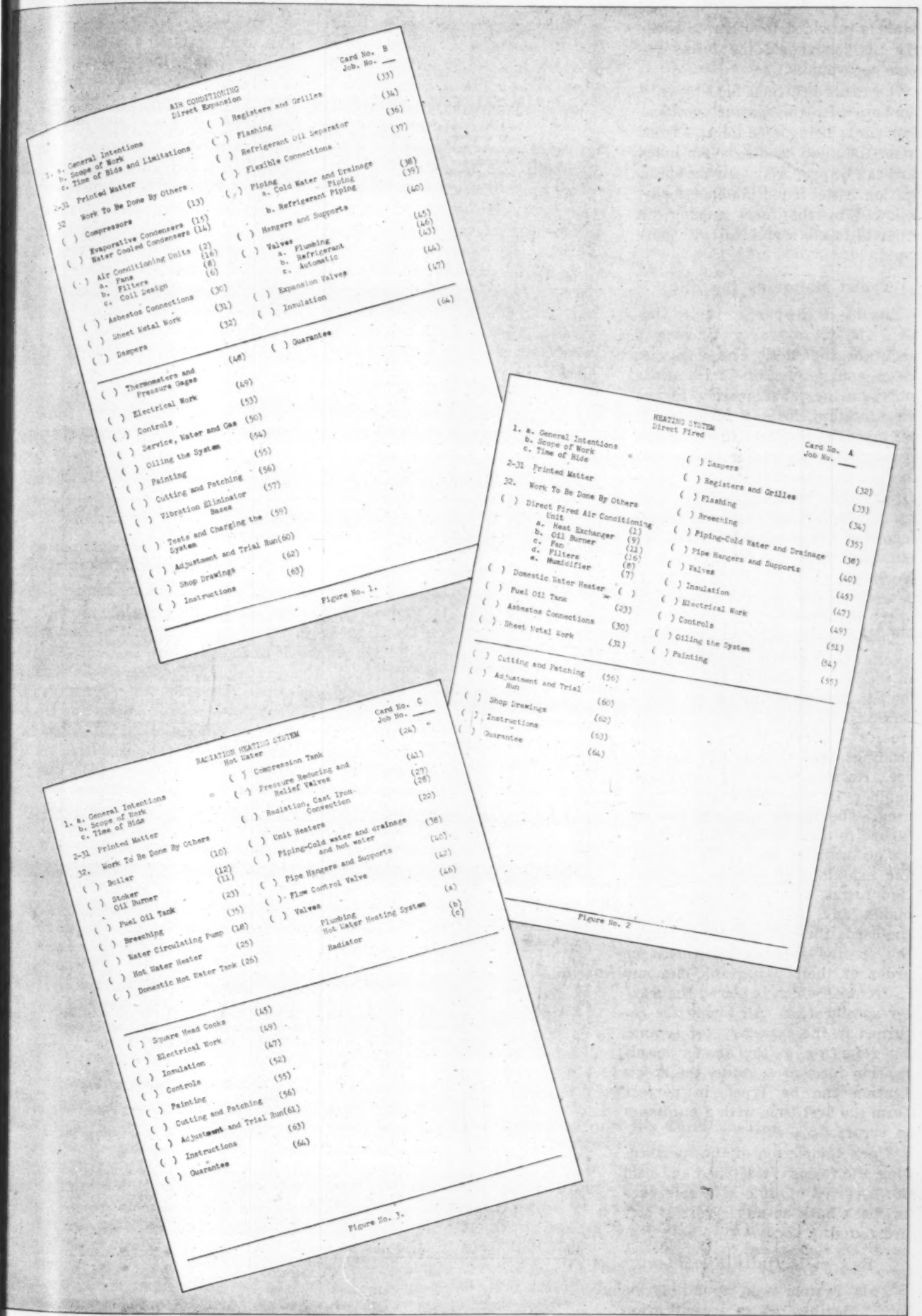
The specifications are of two general types—master specifications and specific specifications. Master specifications were prepared for the various types of design jobs; for example, direct expansion air conditioning system (Fig. 1), direct fired heating system (Fig. 2), radiation heating system, hot water (Fig. 3), etc. These contain the general outline of the desired specifications and the headings of the paragraphs to be used in the finished specifications. In front of the paragraph title is a bracketed blank space, for inserting the paragraph number. At the end of the paragraph title is a numer or series of numbers. These numbers are the numbers of the specific specifications which are to be used in preparing the final specifications. The paragraphs as noted on the master specifications include all possible items which can or should be included in the completed specification of a first-class job.

SOMEONE ONCE described a modern office building as a huge filing cabinet inhabited solely by people whose job in life was to keep track of a lot of pieces of paper, and we must admit it often seems that way. Anything that can be done to simplify straight routine is certainly a worthwhile contribution to creative engineering and efficiency. . . . Major Campbell describes here a method of specification writing which he has used and which has been found to put less of the burden on the engineer or designer, and to make more use of semi-skilled clerical help. It is hoped that the scheme (or adaptations) will be found useful by others.

Specific Specifications

The specific specifications are prepared as nearly as possible as they will be found in the completed specification. The paragraph title is immediately preceded by a bracketed blank space into which is to be inserted the paragraph number. The specification is then written as shown in the example of a direct fired heating unit (Fig. 4), coil design, cooling (Fig. 5), and sheet metal specification (Fig. 6). It should be noted that certain quantities are left blank, such as load capacity in Btu per hr, air flow in cfm, and refrigerant temperature. Many specifications can be written out in full and will need no blanks filled in prior to use.

In the upper right-hand corner of the forms is a number assigned to that specification form. That is the number which follows the paragraph title on the master specification forms. Just below that number is a blank entitled "Job No." This



AIR CONDITIONING
Direct Expansion

Card No. B
Job No. ___

1. a. General Intentions
b. Scope of Work
c. Time of Bids and Limitations
2-31 Printed Matter
32 Work To Be Done By Others
( ) Compressors (13)
( ) Evaporative Condensers (14)
( ) Water Cooled Condensers (14)
( ) Air Conditioning Units (2)
a. Fans (16)
b. Filters (8)
c. Coil Design (6)
( ) Asbestos Connections (30)
( ) Sheet Metal Work (31)
( ) Dampers (32)
( ) Registers and Grilles (33)
( ) Flashing (34)
( ) Refrigerant Oil Separator (36)
( ) Flexible Connections (37)
( ) Piping
a. Cold Water and Drainage Piping (38) (39)
b. Refrigerant Piping (40)
( ) Hangers and Supports (45) (46) (43)
( ) Valves
a. Plumbing (44)
b. Refrigerant
c. Automatic (47)
( ) Expansion Valves
( ) Insulation (64)
( ) Thermometers and Pressure Gages (48)
( ) Guarantee
( ) Electrical Work (49)
( ) Controls (53)
( ) Service, Water and Gas (50)
( ) Oiling the System (54)
( ) Painting (55)
( ) Cutting and Patching (56)
( ) Vibration Eliminator Bases (57)
( ) Tests and Charging the System (59)
( ) Adjustment and Trial Run(60)
( ) Shop Drawings (62)
( ) Instructions (63)

Figure No. 1.

HEATING SYSTEM
Direct Fired

Card No. A
Job No. ___

1. a. General Intentions
b. Scope of Work
c. Time of Bids
2-31 Printed Matter
32. Work To Be Done By Others
( ) Direct Fired Air Conditioning Unit
a. Heat Exchanger (1)
b. Oil Burner (9)
c. Fan (11)
d. Filters (16)
e. Humidifier (8) (7)
( ) Domestic Water Heater
( ) Fuel Oil Tank (23)
( ) Asbestos Connections (30)
( ) Sheet Metal Work (31)
( ) Dampers (32)
( ) Registers and Grilles (33)
( ) Flashing (34)
( ) Breeching (35)
( ) Piping-Cold Water and Drainage (38)
( ) Pipe Hangers and Supports (40)
( ) Valves (45)
( ) Insulation (47)
( ) Electrical Work (49)
( ) Controls (51)
( ) Oiling the System (54)
( ) Painting (55)
( ) Cutting and Patching (56)
( ) Adjustment and Trial Run (60)
( ) Shop Drawings (62)
( ) Instructions (63)
( ) Guarantee (64)

Figure No. 2

RADIATION HEATING SYSTEM
Hot Water

Card No. C
Job No. ___

1. a. General Intentions
b. Scope of Work
c. Time of Bids
2-31 Printed Matter
32. Work To Be Done By Others
( ) Boiler (10)
( ) Stoker (12)
Oil Burner (11)
( ) Fuel Oil Tank (23)
( ) Breeching (35)
( ) Water Circulating Pump (18)
( ) Hot Water Heater (25)
( ) Domestic Hot Water Tank (26)
( ) Compression Tank (41)
( ) Pressure Reducing and Relief Valves (27) (28)
( ) Radiation, Cast Iron Convection (22)
( ) Unit Heaters (39)
( ) Piping-Cold water and drainage and hot water (40)
( ) Pipe Hangers and Supports (42)
( ) Flow Control Valve (46)
( ) Valves (4)
Plumbing
Hot Water Heating System (b) (c)
Radiator
( ) Square Head Cocks (45)
( ) Electrical Work (49)
( ) Insulation (47)
( ) Controls (52)
( ) Painting (55)
( ) Cutting and Patching (56)
( ) Adjustment and Trial Run(61)
( ) Instructions (63)
( ) Guarantee (64)

Figure No. 3.

blank is provided in order to identify the job should the forms become separated.

The cards are then filed by card numbers with the master specification cards being filed in the front under their job headings. An index card can be prepared with the specification title listed alphabetically, followed by the form number, in order to locate a specific card more rapidly.

Typist Maintains the Files

The use of the cards is quite simple. The secretary or typist can maintain the files. The designer, after completing his calculations and drawings, has merely to ask the secretary for the forms for—for example—a direct fired heating system. She selects from the files the master specification card for a direct fired heating system (Fig. 2). By referring to the numbers following the paragraph titles, she can select from the file all types of specifications that should or could be used on the job, and gives them to the designer.

The designer then selects all the specifications that he desires to use on the job in question. He numbers the paragraphs on the master specifications he intends to use and crosses out all those paragraph headings that he does not want to use. He also places the paragraph number in the specification form used. The forms not used are returned to the secretary for refile.

The designer then goes through and examines all specific specification forms, fills in all blanks, and makes any necessary changes on the cards themselves. He arranges the specific specification forms in order of their paragraph number, in front of which is placed the master specification. All forms are returned to the secretary for typing. By referring to the master specification form as a guide, the specification can be typed in perfect form the first time with a minimum of errors.

Upon completion of the specification, the forms can be filed and held for a period of time as a reference to check back on any errors if any are found.

System Is Quite Flexible

This system was found to be quite flexible as a specification

Card No. 1.
Job No. ____

( ) DIRECT FIRED AIR CONDITIONING UNIT: Furnish and install (an) air conditioni unit(s) in the basement and attic in the manner as shown on the plans. The unit(s) shall consist of (a) fan(s), filter, steel heat exchanger with combu tion chamber, oil burner, and humidifier, complete with all accessory local controls and assembled in a steel casing of approved design and with a neat appearance. The arrangement of the components shall be such that the dimensions of (the) unit(s) shall approximate those indicated on the plans, and (it)(they) shall meet the following requirements for capacity:

Figure No. 4.

Card No. 6
Job No. ____

Unit No.( )
Par No. ( )

COIL DESIGN, Cooling

( )SUMMER DESIGN CONDITIONS:

a. Standard Outdoor - 95.0°db
- 78.0°wb
b. Specific Outdoor - ____°db
____°wb
c. Specific Indoor - ____°db
____°wb

( )COOLING COIL DESIGN

a. Heat Load:

Room Load BTU/H	Total Load BTU/H
1. H_L _____	4. H_L _____
2. H_S _____	5. H_S _____
3. H_T _____	6. H_T _____

b. Total Air _____ cfm
c. Vent. air min._____ cfm
d. Vent. air max._____ cfm
e. Air through coils_____ cfm
f. Air entering coils_____ °db
_____ °wb
g. Air leaving coils_____ °db
_____ °wb
h. Max. air vel. through coil _____ fpm
i. Max. pressure drop of air through coil--_____"of water.
j. ___rows of coils min.
k. ___°F saturation suction temperature based on 12°F superheat.
l. ___ gpm of water through coil.
m. ___°F entering water temperature
n. ___ psi water pressure drop through coil.

Figure No. 5

Card No. 31
Job. No. ____

( )SHEET METAL WORK: All ducts shall be constructed as directed and as shown on the plans of _____Iron as hereinafter specified. Metal seams and reinforcing shall be in accordance with the following table:

SHEET METAL GAGES FOR RECTANGULAR DUCT CONSTRUCTION

GAGE	WIDTH OF DUCT	SEAM	REINFORCED SEAM
26	Up to 12 in.	0	
24	13 in to 30 in	1	
22	31 in to 48 in	1	
22	49 in to 60 in	1½	1/8 in x 1-3/8 in
20	61 in to 90 in.	1½	1/8 in x 1-3/8 in

All ventilation air louvers exposed to the weather connected to inside ducts shall be constructed of 16 oz copper and shall be equipped with 1/4 in mesh copper screening over the openings. All ventilation air louvers exposed to the weather connected to ducts and equipment also exposed to the weather shall be of the same material as the material it is connected to.

Figure No. 6.

could be changed by merely removing the cards from the files and replacing them with new forms. Should it be necessary to write a new specification for only one job, the specification could be inserted with a minimum of change or confusion. This procedure eliminates the necessity of a long-hand written specification which is sometimes very difficult for a secretary to decipher, and it also eliminates the possibility of errors in the case of dictated specifications.

Should it be found that a specification is no longer applicable, it can be removed from the files and replaced by an up-to-date specification. It makes it possible to maintain consistency in writing specifications, and when it is desired to locate a specific item in the published specification, it can be done with little effort on the part of the engineer or contractor as the components will always be in the same relative order in all specifications of a similar type.

The time and money consumed in cutting stencils and preparing forms is more than balanced by the fact that once a specification is prepared, little effort is required in the continued use of the information. The system can be set up in about two months without interfering much with the scheduled work and thereafter will need little additional attention. The only maintenance needed is to revise specifications and occasionally add new ones as the need arises.

The system could be expanded to the point where a specification could be prepared for a specific product and could be used where it is desired to use that product. Manufacturers could furnish specifications on 5 in. by 8 in. cards to engineers and architects for their use. Should the product be changed appreciably, the manufacturer could forward to the engineer or architect a new batch of the revised specifications. This procedure would save the designer much research work.

As the above system was not used for an extended period of time, it is very likely that there are a number of flaws which have not been encountered. Should anyone be using a system similar to the above, the author would appreciate any comment on procedure, etc., so that the system can be perfected.

Reducing Heat Loads in Industrial Air Conditioning

In a paper which was scheduled for presentation at the 41st annual meeting of the American Society of Refrigerating Engineers, L. R. St. Onge of the York Corp. discusses several methods of Reducing Heat Loads in Industrial Air Conditioning.

Certain types of industrial plants are often not considered as feasible for air conditioning because of large heat loads. A case in point is a plant designed and built for the production of electron tubes. Though the building was made windowless (for effective dust control) and was insulated, the manufacturing process required that large amounts of city gas be burned in multiple jets on various machines. Of the total high sensible heat load the heat from burning gas and that dissipated from hot surfaces represented more than 50 per cent.

The author describes the manner in which especially designed exhaust hoods were used to remove this heat at or near the source. The use of insulation on annealing ovens and on an electrically heated machine is also described. The sensible heat load for a plant having a floor area of 181,000 sq ft was reduced from 1524 to 963 tons and the corresponding required air circulation at 20 deg diffusion was reduced from 4.8 to 3.1 cfm per sq ft.

Freezeproofing Coal Shipments

The receivers of coal in carload lots are constantly faced with the problem of freezeups in cold weather which interfere with unloading. While this would seem to be a rather simple problem, a simple remedy has not been found. In fact, this has been the subject of an investigation by the Battelle Memorial Institute under the auspices of Bituminous Coal Research, Inc., 719 Oliver Bldg., Pittsburgh 22, Pa. A report of the study is contained in a paper, Freezeproofing Coal Shipments, by R. A. Sherman, supervisor, and J. F. Foster, assistant supervisor of the fuels division of the institute. This paper is also designated, by the sponsor, as information bulletin No. 7.

Because of their effectiveness, ready availability, and comparatively low cost, calcium chloride and rock salt are the most common materials used for freezeproofing. The latter, however, is effective only for temperatures above —6 F. In addition to indicating the theoretical quantities of these materials which are required to prevent freezing of surface moisture, the authors discuss modifications which are necessary because of variations in the rate of drainage of surface moisture while in transit, the effect of rain and snow, and the effect of condensation in the coal bed near the walls of the cars. Also discussed is a comparison of the advantages of adding the chemicals in solid or liquid form and suggested rates of treatment are given.

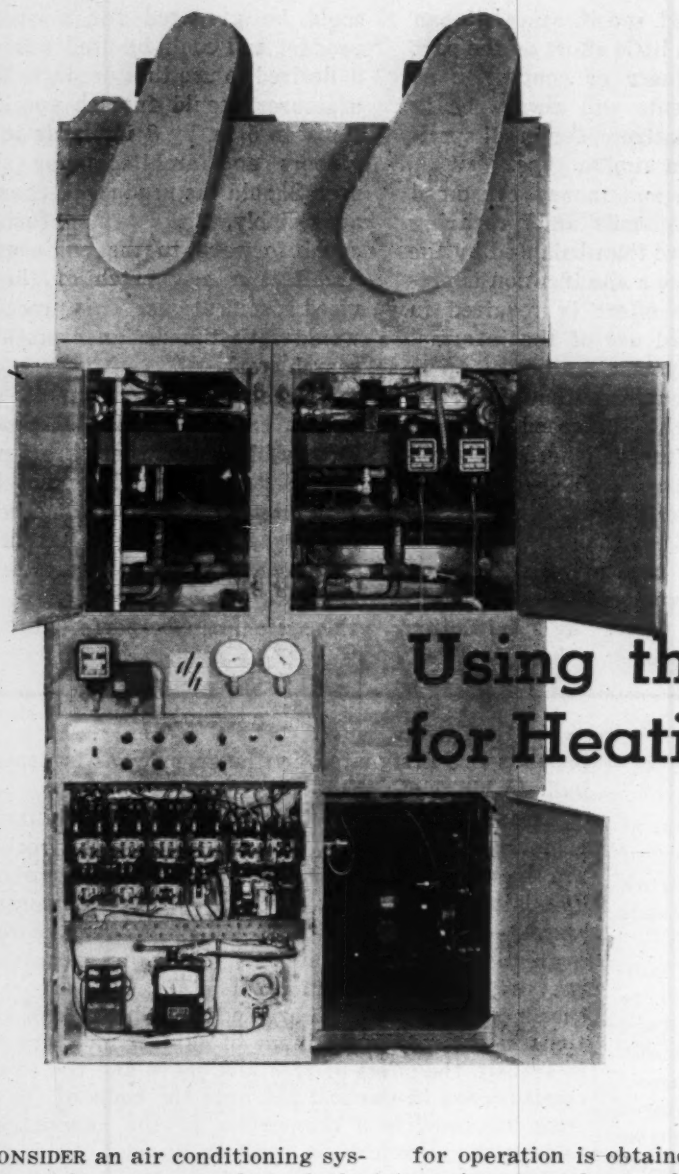
The practical information for coal shippers in regard to concentrations and the various methods of application, which is contained in this initial report, is the result of tests on 10 shipments aggregating 54 cars of 2-in. x 0 coal. Further investigations are planned.

Chemical Exposition In Chicago

The National Chemical Exposition, sponsored by the Chicago section of the American Chemical Society, will be held September 10-14 in the Chicago Coliseum. Headquarters of the Chicago section is at 1515 S. Wabash Ave., Chicago 5, Ill.

Refrigeration and Air Conditioning Show in Cleveland

The mammoth Cleveland Auditorium will be the scene of the 1946 all-industry refrigeration and air conditioning exposition scheduled for October 29 to November 1. Plans for this show, put on by the Refrigeration Equipment Manufacturers Association, are under the direction of K. B. Thorndike, a newly elected director of REMA. Association headquarters is at 43 E. Ohio St., Chicago 11, Ill.



Packaged unit of 5 ton capacity for cooling and reverse cycle heating

Using the Reverse Cycle for Heating, Conditioning

By G. E. CLANCY

CONSIDER an air conditioning system which—on every day of the year, regardless of the weather or the season—maintains within the conditioned space exactly the most desirable temperature and humidity, without drafts, and with clean, dustless air. Furthermore, this plant will require no operating attention to such an extent that one knows not whether it is heating or cooling, humidifying or dehumidifying, unless he consults the indicating devices on the apparatus. Frequently, in the spring or fall, the plant may heat in the morning and cool in the afternoon without the operator or occupants being aware of the change.

Now, add to the above the provisions that one apparatus, using all of the same components, performs all the functions without part of them lying idle for periods of a half a year or more. The energy for operation is obtained from one service at good rates due to a uniform load factor. Thus there will be no chimneys, no fire hazard, no soot, smoke or ashes. With the above features combine economical cost of operation, low maintenance and depreciation, and a first cost which is comparable to that of the commonly used types of heating and cooling systems.

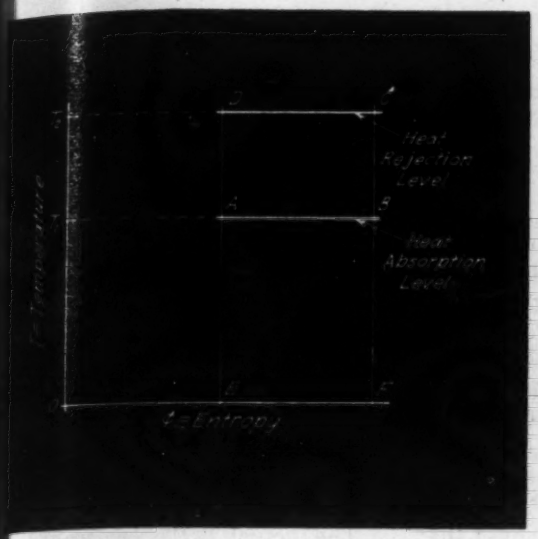
Why Not More Widely Used?

With minor reservations as to first cost, such plants have been built and have been working as described for a number of years. These plants use the heat pump or reversible cycle refrigeration principle. I know of no other practical way to obtain simultaneously all of the features enumerated and which are all obviously desirable.

Why then, have not such systems been more widely used? There are a number of reasons—very few of which reflect adversely on the basic scheme or the ultimate potentialities of such systems:

1) While the basic idea is not new, its application to air conditioning systems is new—for that matter, extensive use of complete comfort air conditioning is in itself comparatively new. Until recently most air conditioning systems have been composed of an aggregation of single-purpose pieces of apparatus often times originally designed for other purposes.

2) The performance and possibilities are in accordance with well known basic principles of thermodynamics, the possibilities having been obvious or cited in work of Carnot, Clapeyron, Thomson, Rankine, Kelvin, and others (most of these works were written about a century ago; in fact, present day refrigerating systems operate on just such a system, as an analysis of their performance will reveal). The average person (and many en-



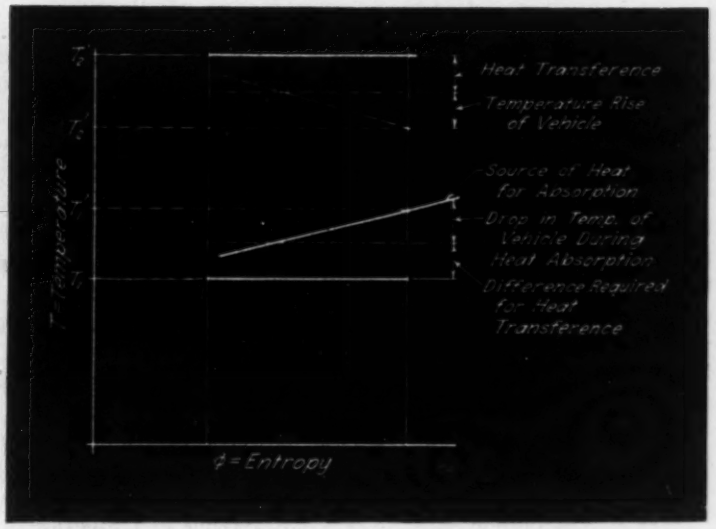


Fig. 1—The Carnot cycle is the simplest basic concept, and recognizes a maximum a ratio of heat input to total heat transference ual to the ratio of temperature lift to the absolute temperature

Fig. 2—There are several reasons why the performance of the perfect cycle cannot be obtained, as indicated in this sketch and the accompanying text

gineers who are not conversant with thermodynamics) insists that "the performance factors realized are impossible," that "they are not possible in view of the laws of conservation of energy," and that "you can't get something for nothing." Such see only the possibility of heat creation. They fail to recognize the possibility of heat intensification, nor do they differentiate between heat quantity and quality. Such an attitude has not helped to further the advancement and acceptance of heat pump cycles.

3) Experimental plants and some ill-advised projects have been attempted with only a meager knowledge of the basic principles. The resulting projects were usually unsatisfactory or even outright failures. Attempts were made to adapt too much standard equipment not entirely suitable for the new scheme. The plants were too complicated, frequently comprising an imposing array of gadgets, instruments, and the like, which added to the cost but not to the performance. Good balancing and proportioning were neglected. Hence, the contention of those who insisted that the reversible cycle system was only an interesting toy seemed justified.

4) When the design was undertaken by competent engineers, skilled in engineering application of thermodynamic principles, the projects were usually designed with elaborate consideration of local conditions (especially for the particular project involved). Frequently they went too far in attempting to realize the highest possible performance ratio. This resulted in a good plant for the place in which it was used, but one that was expensive in first cost and by no means universally adaptable — not even for a given locality.

5) Not until recently has the possibility of sale of such systems warranted standardized design, packaged units, and volume production.

6) Only within the last 15 years have there been available, at reasonable prices, refrigerants which are suitable for such projects. Apparatus for the effective use of these new refrigerants (usually halogen derivatives of hydrocarbons) followed even later.

The foregoing has been presented in explanation of—not as apology for—the slow development of heat pump cycles up to a somewhat recent date.

The Carnot cycle is the simplest basic concept, and because it recognizes as a maximum a ratio of heat input to total heat transference equal to the ratio of temperature lift to the absolute temperature (the absolute temperature at the lower level in case of cooling or the higher level for heating), it is a convenient basis of comparison and orientation, but it is not very useful in detailed analysis of an actual case. So, for the sake of simplicity of illustration, let us first consider the problem from such a viewpoint.

THE HEAT PUMP

REVERSE REFRIGERATION is the use of the refrigeration compressor for pumping heat into a building, rather than for pumping it out. The refrigeration cycle itself is not, therefore, reversed — it's the objective that is changed. What makes the scheme particularly attractive is the use of the same equipment the year around to heat in winter and to cool in summer. During the heating season, heat from outside air — or from some other source, such as lake, pond, or well water—is pumped by the compressor to a higher temperature level for introduction to the building . . . G. E. Clancy, engineer with Drayer-Hanson Inc., presents here some of the fundamentals of refrigeration and the refrigeration cycle and its heat pump or ("heat intensifier") use.

Performance of Perfect Cycle

Referring to Fig. 1, the cycle consists of: (1) Heat absorption from A to B at constant temperature. (2) Adiabatic compression (constant entropy) from B to C. (3) Heat rejection at constant temperature, C to D. (4) Expansion at constant entropy D to A. The heat added is represented by the area $ABCD$; Q_1, the heat absorbed, is $ABFE$, and Q_2, the heat rejected, is $DCFE$.

Therefore, the ratio of heat added to heat delivered in a heating cycle is

$$\frac{Q_2 - Q_1}{Q_2} = \frac{T_2 - T_1}{T_2}$$

or in the case of cooling, the ratio of heat added to heat absorbed is

$$\frac{Q_2 - Q_1}{Q_1} = \frac{T_2 - T_1}{T_1}$$

These are the expressions usually used in power production analyses, wherein the power is a fraction of the heat input, hence the performance factor is always a fraction (less than one). In the case of heat pumps, the cycle is reversed and performances are usually stated as the reciprocals of the above, as follows:

For heating, the ratio of heat delivered to heat added is

$$\frac{Q_2}{Q_2 - Q_1} = \frac{T_2}{T_2 - T_1}$$

which is always more than one unless T_1 is absolute zero, in which case the factor would be one.

For cooling, the ratio of heat absorbed to heat added is

$$\frac{Q_1}{Q_2 - Q_1} = \frac{T_1}{T_2 - T_1}$$

and of course this may vary from 0 if T_1 is absolute zero, to approach infinity as T_1 approaches the value of T_2.

Why "Perfect" Ratios Aren't Obtained

Even with such a perfect cycle (which, incidentally, is independent of the fluid involved) the realization of such ratios would be impossible if only the temperature of the heated space and that of the source from which heat is absorbed at the lower level are considered, because:

1) For heat transference from the thermodynamic fluid in the cycle to the space or fluid to be heated, and from the source supplying heat at the lower level to the cycle, there must be a difference in temperature. Otherwise there would be no flow of heat into the cycle or from it.

2) Some vehicle must exist for carrying heat to the cycle and from it, usually air in the second case and either water or air in the first. In some instances, there may be a secondary intermediate vehicle in either or both of the processes. Since there must be a rise in temperature of the vehicle in one case and a drop in temperature in the other, there must be a further difference of temperature between the heat rejection level of the cycle and final temperature of utilization or discard, and a difference between the heat absorption level of the cycle and the temperature of the initial heat source.

Of course, if the quantity of the vehicle circulated is very large in comparison to the amount of heat conveyed, this temperature change in the vehicle might be quite small; but in this case, the power expended for circulation of the vehicle would be inconsistent with the performance ratio of the basic cycle, and hence the performance would not be so economical.

So that where, on superficial consideration, it might be expected to approach a performance ratio (for heating) of

$$\frac{T_2}{T_2 - T_1}$$

we are actually limited to an ideal maximum of (see Fig. 2)

$$\frac{T'_2}{T'_2 - T'_1}$$

Let us now proceed to considerations of actual cycles which would be encountered with available thermodynamic fluids and advisable mechanical construction.

The Simple Conventional Cycle

The simple conventional cycle (Fig. 3), as usually applied to refrigeration and its application for heating, would follow the path *EA'BDKE* with the heat added represented by the area *EA'BDKE*, the heat delivered being *EA'F'GDK*, as compared to the Carnot cycle of heat added represented by *EABC* and heat delivered *EFGC*.

The actual cycle for cooling is represented by heat added, the same as above, but the refrigerating effect is represented by *A'F'GB*. The Carnot cycle for cooling has the same heat input as shown for heating with this cycle, but the cooling effect is represented by *AFGB*.

In the case of cooling, the heat represented by area *CDK* is an outright loss; in the case of heating, this is utilized, but in its initial quantity with no accompanying lift of additional heat from the lower level. The area *EAA'* represents the loss of power which might have been reclaimed by adiabatic expansion because only isodynamic (constant total heat) expansion is mechanically practical. *EA'F'F* represents a loss of heat delivered in the heating cycle and *AA'F'F* a loss of refrigerating effect when cooling.

The compressor is never perfect in its performance. Inefficiencies are always present, due to mechanical friction, turbulence in the cylinder, etc. Hence, the actual path of compression will be along the

Fig. 3—The simple conventional refrigeration cycle, as applied to cooling and to heating, is illustrated by this sketch, which is explained further in the text

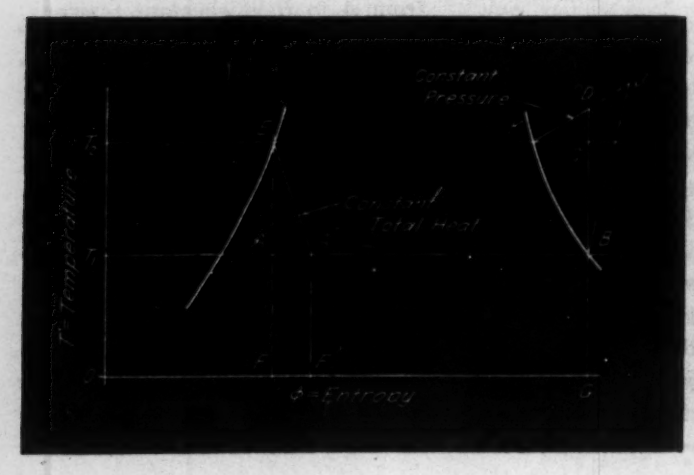
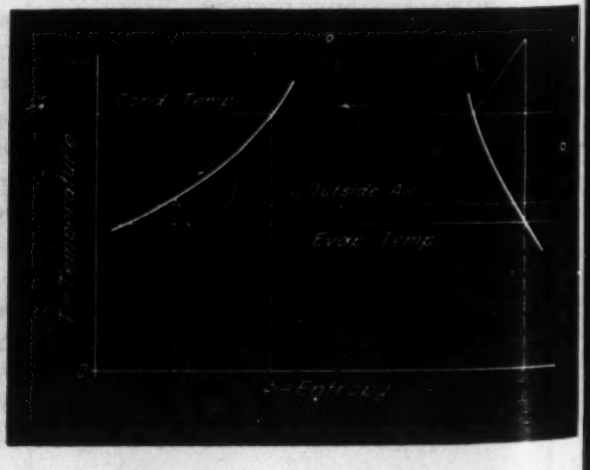


Fig. 4—Considering a system where the heat is absorbed from the outside atmosphere the cycle may become that shown here



line *BJ*. Here again the loss *BJD* is delivered as heat but without lifting other heat in the heating cycle. It is a total loss in the cooling cycle. Most of the power delivered to the compressor is transmitted for delivery as heat in the heating cycle, but only part of it accomplishes intensification of other heat from the lower level. This is dependent upon the fluid used in one case and the compressor efficiency in the other. Of course it must exclude the power loss *EAA'*, which is rejected as heat to the lower level.

There is a worthwhile improvement of the heating cycle, which is quite marked in some conditions. This is especially true if a halogenated hydrocarbon refrigerant having a low latent heat, hence a large quantity of liquid circulated per unit of capacity, is used—and such is usually the case.

Heat Absorbed from Outside Air

Then let us consider a system wherein the heat is absorbed from the outside atmosphere.

For ventilation (maintenance of proper "freshness" of the air in the conditioned space) make up air must be introduced into the stream of air to be heated. The quantity of this make up air is nearly always such that the amount of heat required, to raise it to the heat delivery level, is equal to (or greater than) the difference between the heat of the liquid at the upper level and the lower, so the cycle may become as shown in Fig. 4.

In some cases this gain can amount to as much as 15 to 20 per cent of the total capacity, with no increase in power input.

Usually it seems inadvisable to attempt to use the reversible cycle process where the temperature of the heat source for the heating cycle is much below 10 F. When the temperature lift is quite high, compounding (multistage compression) or the use of boosters might in some cases be worth considering. But generally, when these conditions exist, the basic performance ratio is such that the use of a heat pump system would be inadvisable even if it could be made mechanically perfect.

[This is the first of a group of articles by Mr. Clancy on this subject.]

GERMAN AIR CONDITIONING SURVEYED

The German air conditioning and refrigeration industry is from five to 10 years short of American standards in the field, a three month survey of German industrial plants reveals. Methods and materials utilized by the Germans are generally inferior to those used in America, and in addition, the scope of the German refrigeration and air conditioning activities is limited in comparison to services offered by manufacturers in this country.

The report was prepared for the United States Army's technical industrial intelligence committee, an advisory body to the Joint Chiefs of Staff, by Gunnar Berg, air conditioning and refrigeration engineer for the Westinghouse Electric International Co.

The Germans had not progressed past the experimental stage in air conditioning of railway cars and seldom utilized air conditioning in their factories, even in the underground plants which were resorted to after heavy bombing raids despoiled surface installations.

There was no attempt to venture into the "packaged" air conditioning field, and the Germans had not developed individual room air conditioning units.

In the report Mr. Berg explained that German comfort air conditioning, because of the less severe climate, was confined to such installations as night clubs, theaters, and hospitals. The Reichschancellory in Berlin was partially air conditioned and plans had been made to air condition the Reichstag but were abandoned with the outbreak of war.

Three years before the outbreak of war, copper was on the "verboten" list of materials and steel was used as a substitute. "Freon" was not utilized in Germany until 1939, and then could not be used fully since no design changes were made in the equipment during the war.

Mr. Berg's inspection tour included visits to plants at Frankfurt am Main, Heidelberg, Karlsruhe, Stuttgart, Nurnberg, Wiesbaden, Berlin, Hamburg, Hildesheim, Dusseldorf, and Esslingen.

COST OF AIR CONDITIONING APARTMENTS

An item on the estimated cost of air conditioning apartments, based on information from the Refrigeration Equipment Manufacturers Association, was published on page 113 of the February Heating, Piping & Air Conditioning. Although the original source of the estimated cost of $15.30 per room per season was not stated, this figure was based on calculations given in a publication of the RicwiL Co., entitled A Practical Plan for Incorporating Central Heating and Air Conditioning in a Proposed Suburban Apartment Housing Development.

The plans for incorporating central heating and air conditioning for the project described in this booklet were drawn up by Clyde R. Place, consulting engineers, and the booklet describes the practical and economical aspects of including air conditioning from the same central source as the heating—"an attractive feature for localities where summer cooling is desirable."

SPOEHRER ELECTED REMA HEAD

H. F. Spoehrer, vice-president of the Sporlan Valve Co., was elected president of the Refrigeration Equipment Manufacturers Association at its spring conference. He succeeds F. J. Hood, secretary-treasurer, Ansul Chemical Co., as head of the association, which now comprises more than 90 members.

Other new officers chosen at the REMA meeting are Edward M. Flannery, Bush Mfg. Co., vice-president; Guy J. Henry, Henry Valve Co., treasurer; and C. H. Benson, Imperial Brass Mfg. Co., secretary.

Newly elected to the board of directors are K. B. Thorndike, Detroit Lubricator Co.; G. E. Graff, Ranco, Inc.; R. H. Israel, Virginia Smelting Co.; H. F. Hildreth, Westinghouse Electric Corp.; and J. W. Krall, Tyler Fixture Corp.

Practical Pointers on Reducing Heat Losses from Process, Power, and Heating Equipment in Quiz Form

Check Your INSULATION for better FUEL UTILIZATION

THE National Fuel Efficiency program, conducted during the war in cooperation with the U. S. Bureau of Mines, featured an extensive series of "quiz sheets" on fuel efficiency developed in cooperation with various manufacturer groups and distributed by the program's regional engineers to "waste chasers" in individual plants and buildings. Because the information from these sheets is still just as valuable as it was during the war (saving fuel is always good business), we plan to print a number of them from time to time in HPAC, with the approval of the National Fuel Efficiency Section of the Bureau of Mines, which is part of the U. S. Department of the Interior.

Active volunteer work of the program was brought to a close at the end of the war, as a result of findings of fuel authorities that the fuel situation was no longer serious enough to make it necessary to continue to call on volunteer forces for their help. This does not, of necessity, mean that there is plenty of fuel now available but rather that fuel conservation is a peacetime problem.

In this issue appears the quiz sheet on heating, process, and power plant equipment insulation, which was prepared by an insulation industry committee, and was No. 300 of the series.

Insulation of Heating, Process and Power Plant Equipment

"Loss of heat from exposed surfaces may entail enormous losses of fuel and power. Therefore, a very important justification for insulation is the money saving involved.

"It is of vital importance that all operators of industrial plants survey their equipment and take immediate steps to save fuel wherever possible."*

The British mines department states that, "In the national drive for fuel economy there is probably no single factor, which is common to all industries using heat in its many and diverse applications and which can produce a greater saving in fuel, than efficient insulation."†

The following questions concerning insulation should be answered to realize maximum fuel conservation and return on investment; read questions and suggestions, then survey your equipment with these in mind.

1) Has all bare heated equipment been insulated?

Provide adequate insulation on all bare heated surfaces above 150 F. Insulation which has been removed for any reason should be promptly and carefully replaced. In this respect, valves, flanges, and fittings should receive particular attention.

*Bureau of Mines I. C. 7263.
†Fuel Efficiency Bull. No. 2.

2) Is the insulation thickness sufficient on equipment already insulated?

Look for excessive condensation from traps serving saturated steam lines and excessive temperature drop in pipe lines carrying superheated steam. If the insulation is not damaged these conditions indicate the need for thicker insulation. Inspect all insulated equipment; as a rough check, if you cannot hold your hand on the surface, additional insulation is justified. More exact analyses of the proper thickness based on hours of operation, value of heat, equipment temperature, conductivity of insulation, fixed charges on insulation, and pipe size, may be made by charts or calculation if desired.

3) Have you gone over your plant to determine where fuel may be saved by the use of insulation?

Here is a partial list of equipment used in various plants; much of this equipment is frequently neglected. (Mark the items "S" for "satisfactory"; "I" for "insufficient insulation"; "U" for "uninsulated."

A. Boiler and Accessory Equipment:

1. Brick settings .....
2. Drum heads .....
3. Mud drums .....
4. Feedwater heaters .....
5. Breechings .....
6. Economizers .....
7. Hot draft fan housings .....
8. Stacks—Insulate to the roof to get better draft.....

B. Heated Pipe and Fittings:

1. Steam, hot water, or process piping .....
2. Exhaust and return lines.....
3. Flanges, valves, traps, fittings
4. Steam accumulators .....
5. Feedwater lines.....
6. Gage lines .....
7. Underground steam and hot water lines.....

C. Miscellaneous Heated Equipment:

1. Ovens .....
2. Stills .....
3. Tanks and towers .....
4. Ducts and flues .....
5. Furnaces .....
6. Regenerators .....
7. Kilns and dryers .....
8. Treaters .....
9. Mixers .....
10. Cookers .....
11. Lehrs .....
12. Heat treating equipment .....
13. Metal melting equipment .....
14. Preheaters .....
15. Heat exchangers .....

D. Other Heated Equipment:

1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. .....
8. .....
9. .....
10. .....
11. .....
12. .....
13. .....
14. .....
15. .....

4) Is your insulation properly applied?

a. The insulation should be applied tight against the equipment to prevent air spaces which often promote air circulation between the hot surface and insulation with a resulting loss of heat.

b. It should be securely attached to the equipment to prevent sagging under vibration, etc.

5) Is all insulation protected against moisture, abrasion, knocks, or general rough treatment?

a. Provide a waterproof finish on insulation which is located outdoors or is periodically washed down with a hose.

b. Insulation located where it may be subjected to impact or abrasion should be protected by means of a sheet metal jacket or a suitable bumper.

c. If insulated surfaces must be walked on, or ladders placed against them, thus causing abrasion, install runways or scaffolding to protect the insulation. This is especially important for equipment located outdoors to avoid the entry of moisture from rain or snow.

d. Canvas finished insulation should be painted with two coats of lead and oil paint.

A VALUABLE feature of the wartime National Fuel Efficiency Program was the extensive series of "quiz sheets" containing tips on methods of conserving fuel in the use, operation, maintenance, and repair of various items of piping, heating, and air conditioning equipment. Because fuel conservation—a wartime necessity—is always good business and sound engineering, HPAC is publishing the information from these sheets. Practical pointers on insulation of heating, process, and power plant equipment are given this month.

e. Provide suitable jackets where lines are exposed to strong alkali or acid fumes.

6) Is insulation periodically inspected to detect need for repairs and replacements?
Yes .... No ....

a. Signs of failure in canvas coverings are often due to the insulation loosening from the pipe. In such instances the insulation should be carefully wired back into place and any joints pointed up with insulating cement. Replace and paint the canvas.

b. Insulation which has been permanently distorted and thus had its air space structure ruined, has lost much of its ability to prevent heat loss.

7) Do you inspect insulated equipment at regular intervals to detect conditions which might damage the insulation or make it less effective?

a. Examine all waterproofed lines to be sure that no cracks or openings have developed. Wetting causes loss of efficiency and deterioration of insulation.

b. Eliminate water hammer or minimize excessive vibration in insulated pipe lines as it may cause joints to open or otherwise reduce the efficiency of the insulation.

c. Stop leaks in either steam or hot water lines as soon as possible. Steam impinging on pipe covering may cause rapid deterioration. Water from a leak may follow along a pipe for a considerable distance, saturating the covering, thus destroying the insulating value.

War Plant Wasted Lots of Fuel; Changes Made Save 26%

THIS IS THE case history of the heating of a large industrial plant. It comprises a good-sized office building two stories high, several lofty structural steel shops hundreds of feet long (each with traveling cranes constantly in operation for handling very heavy material), several buildings for making and storing wood patterns, and many outlying shop offices and locker and toilet rooms scattered in strategic places over the 10 acre property. There is a central steam boiler plant for heating. The ground is near a river subject to frequent overflow, and the original swamp was surfaced with bituminous coal cinders and ashes that are in water-saturated condition.

The original main steam distributing pipe and a parallel return main for about one-half of the job were placed in a closed-over concrete trench along with many electric conduits. This trench is about 4 ft wide and 4 ft deep. The steam main was insulated with ordinary asbestos and a vacuum pump in the boiler house was expected to lift the condensate several feet up out of the return pipe in the trench. The plant size increased rapidly and many additions were made to the original buildings, and new detached buildings of varying sizes and quality of materials were added from time to time.

The concrete pipe trench was not watertight and it had a drain that was expected to spill to the river. The river backed up and submerged the pipe trench several times each year. The insulation soon fell off the steam main. The return main eventually leaked so seriously that it was abandoned. The electric conduits short-circuited, and new overhead electric distribution was required. Condensate from the steam main in the pipe trench then was trapped to the sewer and was blown out under boiler pressure if the sewer was submerged. There was not enough space in the concrete trench to make any inspection or repairs. The condensate from each heat transmitter served by the steam main in the pipe trench was piped through a hole in the outside wall of the building to spill on the ground.

When the first new building was constructed, about 1941, a 75 psi

I.C.R.R. Magazine

Modernization Saves Fuel

pressure steam line was buried, uninsulated and unprotected, in the cinder fill, with an uninsulated return main also below the vacuum pump inlet, run back to the boiler house. This return main lasted at most for two years, then had to be replaced.

Condensate Return Abandoned

The stress of heavy war production made this replacement a nuisance, so that various traps on this system were given outlets through the walls to blow clean hot water out-of-doors. As building after building was added, with dim realization of the sure trouble to come from buried and unprotected piping, it became the custom to run boiler pressure steam mains overhead on posts, sometimes for distances of as many as 500 ft. This idea of letting the condensate traps on the ends of mains and on the outlets of heat transmitters blow out on the ground solved so many problems quickly that it was adopted universally, and all attempts to return the condensate were abandoned.

The boilers, of course, attempted to retain all the mud and scale introduced with the make up water, but plenty of patent boiler water compound was expected to correct this little trouble.

Eventually the three big boilers finished their tour of duty and were condemned. The boilers were encased in masonry that had cracked and settled, and the air that leaked through the cracks so nearly satisfied the chimney that little draft was left to fan the fire. Brick encased boilers, as a natural result, are unpopular in this plant, but no one ever attempted to plug an air leak in the boiler walls.

Owing to the ground water situation plus the cinder fill terrain, and because so much of the steam piping may be run overhead without prejudice—especially since a great deal of it can be placed above the craneways inside the buildings—the solution was to continue overhead distribution. It was not particularly difficult to install an outlying electric vacuum pump at or near the ends of each of the six principal steam mains, and to connect all condensate traps in each of these divisions to the respective pump. The pressure returns from each division are placed overhead alongside the steam main and even-

In this regular feature, informal comment on heating, piping, and air conditioning matters is given by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors. . . . Under the stress of war production, the plant he discusses this month was wasting a great deal of fuel, and the changes that have been made are saving well over 26 per cent. Conditions of this kind should be corrected as soon as possible to get ready for production in the competitive days ahead.

tually reach a receiver in the boiler house. Boiler feed pumps then deliver the water to the new boilers. The overhead steam and return mains are all insulated separately and then the two are further insulated and protected with a waterproof jacket. If the steam pipe is warm, the return pipe cannot freeze.

Use of Unit Heaters

Occasionally there is a building or room of considerable size in which the existing heat transmitters are below the steam mains and remote from a low-down vacuum return main. This situation was solved by installing a steam heated hot water converter above the overhead steam and return mains, with an electric circulating pump and with hot water as the ultimate heat carrier. Where freezing might occur, this closed liquid system is dosed with ethylene glycol after the lesson of one's automobile radiator.

In some cases, leanto buildings could be served by installing unit heaters near them, above the overhead mains, and by extending metal ducts from these heaters down to recirculate the air in the low buildings or rooms.

Some of the outlying small offices and toilet rooms, too remote for reasonably economical steam heating, were equipped with gas burning unit heaters under thermostatic control.

It was demonstrated that a saving in fuel of more than 26 per cent was made by these changes in the distribution system alone, without taking into account the savings gained by more efficient boilers and automatic combustion control. This percentage of saving is without any attempt to express in dollars the economies achieved by reduction of scale and mud in the boilers and the saving by ceasing, during many days of the year, to boil the river water in the submerged pipe trench around the long steam main. This entire pipe trench system was abandoned.

There are undoubtedly other industrial plants in this country in which equally reprehensible conditions now exist, and which could be corrected to great advantage.

Air Conditioning Prevents Roof Falls in Coal Mines

In some coal mines the control of strata above the coal beds is a major problem since falls of strata may result in decreased production, increased accidents, inadequate ventilation, and excessive maintenance costs. Mine roof falls may be caused by one or a combination of several factors, such as (1) inherent weakness of the roof rock, (2) extraction of excessive area in advance mining, (3) insufficient timbering, (4) inadequate roof control in retreat mining, (5) mining at depths where the roof rock is not strong enough to support the overburden, and (6) weakness of the roof rock due to variations in temperature and moisture content of the mine air.

A water spray type air conditioning system was installed at the Beech Bottom Mine, near Wheeling, W. Va., of the Windsor Power House Coal Co. in order to reduce roof falls caused by variations in temperature and moisture content of the intake air. An investigation to study the functioning of this system and to determine whether or not it has been effective was undertaken by the U. S. Department of the Interior, Bureau of Mines. A 20 page report, A Study of Summer Air Conditioning with Water Sprays to Prevent Roof Falls at the Beech Bottom Coal Mine, West Virginia, which is identified as R. I. 3775 and dated August 1944, was prepared by E. L. Fish, L. A. Turnbull, and A. L. Toenges, assistant mining engineer, senior mining engineer, and principal coal mining engineer, respectively, of the fuels and explosives branch, Bureau of Mines, Pittsburgh.

The sections of the mine which are air conditioned in summer are sealed off from the rest of the mine by air locks. The system consists of an axial flow exhaust fan which averaged 72,000 cfm in 1942 and 78,000 cfm in 1943, together with water cooling sprays. Four banks of sprays are located on the surface in the natural supply system and four banks are also located on the surface at the mine air discharge. The water system circulates 600 gpm, of which about 7 gpm is makeup water pumped from a nearby spring. The air entering the mine is cooled by the water spray at the inlet to the ventilating shaft. The warmed water is passed through the sprays located at the exhaust outlet and is cooled by the relatively cool mine air. A counterflow system is used throughout, together with a system of storage and overflow tanks.

Samples of shale rocks from the mine were subjected to laboratory tests, and Irving Hartman, senior physicist, experimental coal mine section, Bureau of Mines, Pittsburgh, prepared the laboratory report which is included in this paper as an appendix.

The investigation indicated that the roof rock in this mine is affected more by variations in moisture content of incoming air than by changes in temperature. Alternate wetting and drying of the roof caused it to disintegrate and fall. It was also evident that moisture is absorbed from the roof rock in winter and deposited on the rock during the summer.

Deposition and absorption of moisture by the incoming air can be reduced by controlling the temperature and moisture content of the incoming air. If the temperature of the incoming air is near or the same as the temperature of the mine rock and the normal moisture content of the intake air is in equilibrium with the moisture content of the rock, little or no absorption or deposition will take place. Air conditioning is therefore desirable in winter as well as in summer.

MEETINGS & CONVENTIONS

Foundrymen's Association 50th Anniversary Convention

May 6-10 has been set for the 50th anniversary convention of the American Foundrymen's Association. Some of the highlights of the 60 odd sessions, which will be held in Cleveland, include a paper to be presented by D. F. Sawtelle on core shop practice in a mechanized iron foundry producing pipe fittings, a panel presentation of buyer's viewpoints on foundry inspection, symposiums on the properties of grey iron castings for design engineers, a paper by H. F. Bishop and H. F. Taylor, of the U. S. naval research laboratory, on bore cracks in cast steel valves and fittings, and a discussion of new techniques in the casting of many ferrous and nonferrous metals and alloys. Association headquarters is at 222 W. Adams St., Chicago, Ill.

Corrosion Engineers Annual Meeting in Kansas City

The 1946 annual meeting, May 7-9, of the National Association of Corrosion Engineers will be held at the President hotel, Kansas City. Association headquarters is at 711 Main St., Houston 2, Tex.

Marine Exposition in New York City

The National Marine Exposition is scheduled for May 20-25 at the Grand Central Palace, New York City. Headquarters is National Marine Expositions, Inc., 17 Battery Pl., New York City.

HPACCNA to Meet May 22-25

The Ritz-Carlton hotel, Atlantic City, N. J., will be the scene, May 22-25, of the 57th annual convention of the Heating, Piping and Air Conditioning Contractors National Association. Details concerning the program and entertainment will be announced at a later date by the association whose headquarters is at 1250 Sixth Ave., New York 20, N. Y.

Stoker Manufacturers Meeting Scheduled for Colorado Springs

The Broadmoor hotel, Colorado Springs, Colo., will be the scene of the 1946 annual meeting of the Stoker Manufacturers Association. The association, whose headquarters is at 307 N. Michigan Ave., Chicago 1, Ill., will hold a two day meeting, June 3 and 4.

ASRE Spring Meeting Set for June 3-5

Members of the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18, N. Y., will meet at the St. Paul hotel, St. Paul, Minn., June 3-5, for the 32nd spring meeting of the society.

NDHA to Meet at Virginia Beach

The National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6, Pa., will hold its 1946 annual meeting June 3-6 at the Cavalier, Virginia Beach, Va.

ASHVE to Meet on Excursion Boat

The dates for the 1946 semi-annual meeting of the American Society of Heating and Ventilating Engineers, which will be held in Montreal, Canada, have been changed to June 10-12. The meeting will open at the Mount Royal hotel and will continue aboard the cruise ship, Quebec, up the St. Lawrence with stops at Quebec, Murray Bay and Tadoussac. F. A. Hamlet, Leo Garneau, and S. W. Salter will act as general chairman, vice-chairman, and secretary, respectively, of the committee on arrangements.

A. V. Hutchinson, secretary of the society, 51 Madison Ave., New York 10, N. Y., has announced that special reservation forms for the cruise will be sent to members and that requests for hotel rooms should be filed promptly. Train reservations should be made as soon after April 27 as possible. Special cars will be available from both eastern and western cities.

ASME Meetings Scheduled

The following meetings have been scheduled by the American Society of Mechanical Engineers, 29 W. 39th St., New York City: the semi-annual meeting in Detroit, June 12-15; the fall meeting in Boston, September 30 to October 2, and the annual meeting in New York City, December 2-6.

Smoke Prevention Meeting Scheduled for June 23-26

June 23 to 26 are the dates for the annual meeting of the Smoke Prevention Association of America. The Nicollet hotel, Minneapolis, Minn., will be the scene of the meeting and secretary-treasurer of the association is Frank A. Chambers, City Hall Square Bldg., Chicago 2, Ill.

ASTM Annual Meeting in Buffalo June 24-28

The American Society for Testing Materials has announced that its annual meeting in Buffalo, June 24 to 28, will include several technical symposiums, among which will be one (given in cooperation with the Society for Experimental Stress Analysis) on testing of parts and assemblies. Among the other sessions planned will be one on the fatigue of materials and another on pH. Many manufacturers of testing instruments, scientific apparatus, and laboratory supplies have applied for space in the seventh apparatus exhibit which is to be held during the annual meeting on the seventeenth floor of the Hotel Statler. This exhibit is being resumed after a lapse of four years.

While hotel reservation forms are being sent to each member, those who may wish to write now for accommodations should address the ASTM housing bureau, Convention and Tourist Bureau, Inc., 602 Genesee Bldg., Buffalo, N.Y.

NWAHACA Mid-Year Convention Scheduled

The 1946 mid-year convention of the National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14, Ohio, will be held at the Edgewater Beach hotel, Chicago, June 25-26.

BOILER PLANT OPERATING ERRORS

Excerpts from a discussion on smoke abatement in small power plants, by Carroll F. Hardy, chief engineer of Appalachian Coals, Inc., at Midwest Power Conference

SMOKE abatement activities have varied between the extremes of the efforts of one man working part time and the fervor of hundreds joined in a veritable crusade. It is today high on the list of civic improvements for most of our major cities, and very properly so.

Organizations have often clamored for the elimination of smoke without a real understanding of the job involved. Many times only one phase of a smoke abatement plan is promoted by these groups. Such processes as completely dieselizing or electrifying the railroads; taking all the steam and electricity now being generated by small power plants from central stations; prohibiting 90 per cent of the domestic coal; and other such changes are considered easy by the ill-informed. Such byplay often obscures the real problem of abatement of atmospheric pollution.

2200 Plants Surveyed

Unfortunately, we have no way of determining just what proportion of the smoke in any city comes from each source, nor are we particularly interested in the answer, because smoke from *any* source is unsightly and unnecessary. It was on this premise that the Coal Producers Committee for Smoke Abatement was organized and was and is being operated. In 1941, when this committee started to work, a careful compilation was made of all the various claims as to what caused smoke and how one should get rid of it, and then a series of surveys of cities interested in smoke abatement was instituted. This series of surveys is now being continued, and I would like to quote some data from the first 12. Some 2200 plants were incorporated in these 12 surveys, but we will use the data for only those that come in the small power plant group. There are 687 boilers included in these data. Every type of burning equipment is represented in this group. It is apparent that hand fired plants cannot be considered the only smoke violators, nor is any one particular type stoker most likely to be a smoke violator.

Of all the plants surveyed, slightly over 8 per cent were in first class operating condition and were fired correctly. Fifteen per cent had only minor defects and were being operated very well; one-third of the properly operated plants were hand fired and the balance were mechanically fired.

Two-thirds Had "Operational" Difficulties

Two-thirds of the plants had what might be termed "operational" difficulties, with incorrect firing heading the list. This means firing by no particular method, unnecessary stirring of the fire, overloading the firebox, trying to force a cold boiler, poor maintenance and poor housekeeping, and allowing accumulations of soot and fly ash in the gas passages of the boiler and in the chimney and breechings.

In both stoker and hand fired plants, about 5 per cent had leaks in the breeching or in the chimney or had breechings which were poorly designed or had unnecessary turns and restrictions.

Poor draft conditions due to overloaded stacks or failure to keep the stack capacity in step with the addition of new boilers have resulted in operational difficulty. Additional stack capacity or the installation of an induced draft fan to increase the capacity of the present stacks is indicated in these cases.

Of the total number of plants inspected, only 15 were found to have smoke alarm systems and in 16 the fireman could readily see the top of his chimney. In the rest of the plants it was impossible for the fireman to see the top of his chimney without leaving the boiler room, and in many cases he had to climb stairs or walk a considerable distance to see his chimney.

Since it is impossible to determine by looking into the firebox whether objectionable smoke is being made, the necessity of having a smoke alarm, mirror arrangement, or some other way of determining how much smoke is being produced is apparent.

Bad Firing Practices

In both stoker and hand fired plants bad firing practices may be attributed directly to the almost universal practice of having the engineer or fireman so burdened with other duties that he does not have time properly to care for the heating plant. This practice is universal in small and medium sized plants of all types, steam pressures, and load conditions. In the larger plants—where the investment in equipment may be hundreds of thousands of dollars—it is not unusual to find a fireman in other parts of the building doing maintenance or other work.

The fuel bill is a big item of expense to all types of plants. It is often fallaciously assumed that no saving can be made by more detailed attention. Competent supervision and intelligent care can usually save from 10 to 25 per cent of the coal bill in addition to reducing smoke to a minimum.

Many of the plants inspected, particularly those ranging from an installed boiler horsepower of 75 or

THE MIDWEST POWER Conference, sponsored by the Illinois Institute of Technology with the cooperation of nine other colleges and universities, two engineering societies, and the local chapters of six of the national engineering organizations, was held at the Palmer House, Chicago, April 3 to 5. We present here excerpts from some of the papers given at the conference which are of particular interest to HPAC's readers. Each registrant at the conference will receive a copy of the published proceedings, giving the complete papers. The conference secretary is C. A. Nash, whose address is Illinois Institute of Technology, 3300 Federal St., Chicago 16, Ill.

more, were equipped with draft gages, steam flow meters, steam-air flow meters, or one of the many types of combustion controls. Unfortunately, there are no exact data on these installations, but we are being conservative when we say that 25 per cent of this equipment is being operated properly and that is a very liberal estimate.

Meters, Gages, and Combustion Controls

More than half the draft gages could not be read or were not even connected to the boilers. Steam flow meters were often in operation, but a straight line on the chart indicated they were giving very sluggish and inaccurate performance. Many of those which were tested during the survey did not return to zero. CO_2 recorders were most universally either not in operation or not operating properly. In many cases, particularly in the smaller plant, the fireman had changed the combustion control so that only the men actually operating the plant knew how it worked. This included in most cases the removing of the automatic features of the control and using it only as a convenient way of changing the air and fuel flow to fit the load. Oftentimes the survey engineers were told that a meter service man had set the equipment four to 10 years previously, and the plant personnel had never tried to check it or change it since. This would be ridiculous if it were not so tragic.

Poor Maintenance and Housekeeping

Over 70 per cent of the plants surveyed have not been maintained in good operating condition. The survey engineers found burned boiler fronts, doors off the hinges or missing entirely, breechings in bad shape, as well as grates or tuyeres burned, and (very often) faulty controls on stokers, in addition to gas passages full of soot and other evidence of lack of care.

Probably 75 per cent of these poorly maintained plants could be operated without emitting unnecessary smoke if more attention were given to keeping them in repair.

Lack of Coordination

Another serious fault of the management is not distributing the load on the boiler as much as is possible. The usual practice in all plants using process steam is to assume that steam is just as available as water or electricity and can be turned on and off at will. In a large plant, with a number of departments using steam served by boilers having reserve capacity, steam can be furnished in this manner.

However, in the case of a plant likely to be dependent on only one boiler, which is overloaded at peak periods, it is manifestly unfair to impose irregular peak loads without warning. Either the loads should be spread to give as even and steady a load as possible, or some warning should be given in advance when loads are to occur. A little cooperation will keep the plant out of trouble and insure adequate steam pressure when needed.

Lack of Turbulence and Overfire Air

Many plants could be taken out of the violator class by additional turbulence, or better mixing of furnace gases. Additional turbulence and overfire air will oftentimes cure cases of overloaded or improperly installed equipment. It is not always possible to cure "sick" plants by this method but it approaches under the category of a "cure all." Care must be taken, however, to get the proper installation and to see that the equipment is properly operated to get maximum benefits. Hand fired plants in particular can be helped materially by addition of overfire air.

Firing Methods—Hand Fired Boilers and Furnaces

About two-thirds of the firemen in the hand fired plants claimed to be using some variation of the alternate or coking method in firing. In almost every case it was quite evident that the fireman was not following one of these methods.

We recommended when using high volatile coal that only the alternate door or the alternate side and side or alternate front and rear methods be used, leaving the remaining fuel from the previous firing undisturbed. The practice of breaking up the bed of partially coked coal was found in over 19 per cent of these plants. In some plants, due to the smallness of the boiler, this was necessary to maintain steam pressure. In most cases it was unnecessary, and in all cases it was a prolific source of smoke. The practice of trying to force a cold boiler from bank condition to full load in a short time is followed in 9 per cent of the plants. There is only one solution to this and that is to allow more time for firing up. The proper banking of the fire will help this condition, but even then sufficient time must be allowed for the fire to heat up the water in the boiler so that smoke is not produced. The management must allow time for the fireman to get steam up in the morning or after periods of light loads.

Firing Methods—Mechanically Fired Boilers and Furnaces

The firing methods of a mechanically fired plant are not usually considered important as the stoker is semi-automatic. This is not true because careless cleaning methods and excessive manual agitation of the fire result in large amounts of smoke being emitted.

Shoveling coal on top of a stoker fuel bed was found to be practiced in 11 per cent of the plants of all sizes and pressures. This is contrary to the theory of stoker operation and can only result in smoke. It is usually done to pick up load or because the fuel distribution is bad or because the fireman does not like the looks of the fire.

COOLING TOWER SELECTION

Excerpts from a paper by J. Lichtenstein, of the Foster Wheeler Corp., presented at the air conditioning session during Midwest Power Conference

THE COOLING tower is a heat exchanger, and it is the surface which is the essential product sold by the manufacturer. If we assume that, except surface, all other elements which determine performance are alike, the tower with the largest surface offers the greatest insurance that the performance will be accomplished.

The surface in most towers consists essentially of drop surface, which cannot be determined either by measurement or test. All that experimentation will give us is the product of surface and a diffusion coefficient, but not each separately.

The other factors which determine performance—such as the amount of air, its velocity and correspondingly the rate of heat exchange, the pressure drop, and power requirements—are readily ascertained from the manufacturer's proposition. Thus, it is mainly the surface which requires the development of at least approximate methods to enable intelligent comparisons.

The Cooling Tower Surface

Film Type Surface—To overcome the difficulty of the unknown drop surface, one could (of course) provide a geometrically measurable surface and let the water run as a thin film over it, while air passes upward in counterflow.

But the amounts of surface required for cooling are very large and providing film type surface is very expensive. For early tower design, packed towers were used where, by raschig rings or similar means, a large material surface was provided. This type of tower has been abandoned. Aside from the cost of the rings, the pressure drop of the air flowing in a tortuous path through the rings was large, with corresponding high power requirements. Further, the water rarely covered the whole surface, but had a tendency to concentrate and flow in channels, wasting a part of the surface provided.

Drop Surface—It would seem that the cheapest way of providing a large water surface is to divide the water into a large number of small drops by some means of atomization. The smaller the drops, the larger the surface. However, there is a limit to the size of the drop beyond which overall performance would suffer. Too small drops are easily carried out of the tower by the air stream. To hold them back would require a complicated eliminator system, with a high pressure drop and consequent power losses. The drops must be large to overcome the air stream and fall into the tower sump. For this reason a cooling tower does not require high pressure nozzles for atomization. Letting water fall by gravity upon a splashplate results in drops of suitable size.

Dividing the water into drops is only one of the elements for surface creation. The total surface consists of the sum of surfaces of all the drops inside the tower, when steady conditions have been reached. And this total number of drops depends upon the time of fall of a drop through the tower. Since the size of the drops cannot be reduced beyond a certain minimum diameter, it follows that the only element over which the designer has control is the time of fall through a fixed tower height.

The Spray Tower—In early tower design the drops were allowed to fall freely through the tower. The only way to affect the time of fall was the selection of the tower height. Since high towers are expensive, the height had to be kept low and the resulting time of fall and, therefore, the total surface, was not large enough to accomplish severe cooling conditions.

The Filled Tower—To increase the performance of a tower of fixed height, it is necessary to increase the surface and, therefore, the time of fall of a drop through the tower. To do this the tower is divided into a number of parts of equal height. The total time of fall is now the sum of the times of fall for each height and larger than the time of fall over the whole tower height without interruption.

Principles of Fill Design

The Fill Arrangement—It is the purpose of the fill to prevent any drop from falling over a larger height than specified and to accomplish this with a minimum of pressure drop. It is not the purpose of the fill to add film surface. It does so by its existence, but is small compared with the drop surface. A good filling must split large drops into smaller ones and must not be of such shape as to allow an appreciable part of the water to form a film over it. Only experimentation can develop the best fill shape that meets all of the above requirements. But the geometrical arrangement of any fill shape selected is determined by the requirement that no drop should fall through the tower without the specified interruptions. This leads to the following principle: *All filling within the selected volume, if projected on a plane parallel to the ground area, must form a solid deck.*

The Pressure Drop—The best fill arrangement would be one which

leads to a minimum pressure drop. If we assume that the rows of fill are sufficiently apart so as not to interfere with the air flow through each separate row, the pressure drop would be proportional to the number of rows and to the velocity head of the air flowing through the fill shapes.

The Time of Fall—Once the filling layout has been decided upon and with it the number of falls, it is easy to calculate the total time required for a drop to fall through the tower. The laws of free fall can be applied, since the distance of fall is relatively small and the influence of air resistance can be neglected.

Subdividing a spray tower of given height into a number of spray towers of smaller height increases the total time of fall and therefore the surface. This occurs very sharply at first and, with increasing subdivisions, the gain becomes smaller. Since the cost of the tower increases with subdivisions, there is, of course, an economic limit. Few towers, even for extreme conditions, are built with much more than 19 rows of fill. If the selected height of the tower with 19 rows does not give sufficient surface for the required performance, the height of the tower itself must be increased.

The Surface

The total surface in a tower of fixed fill layout could only be determined if the average drop diameter into which the atomization divides the water were known. This is not the case. The average drop diameter varies with loading, which is the amount of water per square foot of ground area. It increases with loading due to coagulation of water drops. Beyond a certain loading, coagulation is so large that sheets of water are formed, reducing the surface abruptly. This is the flooding point of the tower.

In order to make comparisons of the surfaces of competitive towers, it is necessary to revert to indirect methods and to make use of the results of cooling tower theory.

Tower Is a Heat Exchanger

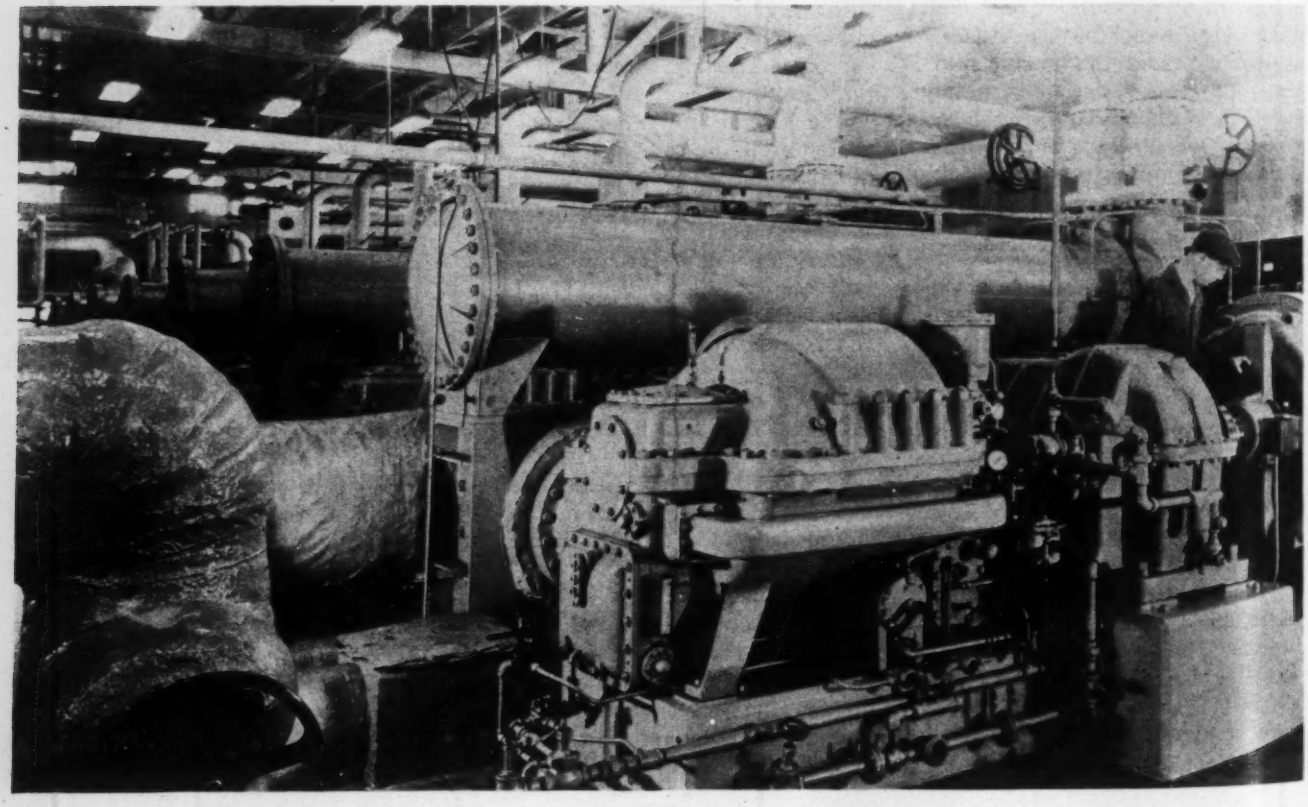
The cooling tower is a heat exchanger. Two sources of heat are exchanged between water and air. One is due to the temperature difference between water and air resulting in a conductive flow of heat. The other is due to evaporation and flow of vapor from the water into the air.

In a cooling tower it is not the air temperature which determines performance, but the air enthalpy. Since air of different temperatures and relative humidities which have the same wet bulb temperature also have very closely the same enthalpy, the performance of a tower will be entirely determined by the wet bulb temperature alone. A hot, dry, desert wind will do the same cooling as a colder but moist air, if both have the same wet bulb temperature.

When specifications are issued for a cooling tower, the hot and cold water temperatures, the wet bulb temperature, and the amount of water to be cooled are all specified. The manufacturer specifies the amount of air through his tower. With this information, the corresponding tower characteristic of each competitive proposal can be determined.

[Mr. Lichtenstein's complete paper contains a number of equations and sketches giving specific information on principles of fill design and heat exchange.]

This illustration from Dr. Carrier's paper (see next page) shows seven of the 14 "Freon-12" compressors and condensers used to refrigerate the altitude wind tunnel and icing tunnel at the NACA aircraft engine research laboratory in Cleveland. Each of these units is driven by a 1500 hp motor.



CENTRIFUGAL COMPRESSORS

Excerpts from a paper presented by E. P. Palmatier, assistant to engineering vice president, Carrier Corp., at session on air conditioning at the Midwest Power Conference

THE two major hydraulic elements of a centrifugal compressor are the impeller and the diffuser. The function of the impeller is to impart rotational kinetic energy to the gas. The diffuser, which in all cases is a stationary part, converts the rotative kinetic energy given to the gas by the impeller into pressure. There are three fundamental types of diffusers—the volute, the vortex or open diffuser, and the vaned diffuser.

The characteristics of turbocompressors are usually given at constant speed by three curves—head or compression ratio, horsepower, and the efficiency. These three characteristics are normally plotted against the common abscissa, displacement. Such characteristic curves are not extended to zero displacement; instead, they are terminated at the surge or pumping point of a machine. Below the pumping point, the delivery of a turbocompressor is unstable and operation is impossible unless the discharge of the machine is connected to a system which prevents reverse flow, or the design is sufficiently rugged to withstand the stresses imposed by the surge.

It might be said that centrifugal compressors may and have been built to compress any dry gas or vapor. (Dry gas is specified because any great amount of free liquid tends to erode impellers.) Corrosive gases can usually be handled if materials are available to resist the corrosive elements.

Range of Available Displacements

The range of available displacements can be roughly defined as from 1500 to 100,000 cfm. The high limit is determined by the size of machine tools available for machining casings and by scarcity of reasonably repetitive applications. The high cost of special design work and tooling usually makes several smaller machines less costly than a single large unit.

The low limit of displacement is established by the unavailability of high speed drive equipment and the cost of high precision manufacture necessary to maintain clearances proportional to impeller dimensions in small sizes. Actually, the low limit of displacement depends on the pressure ratio as well as the intake volume, because it is the displacement of the last stage—not the first—which controls.

The pressure ratio available per stage varies with the molecular weight of the gas. A good backward bladed wheel will develop a pressure coefficient of 0.52 to 0.55. For air, this amounts to a pressure ratio of 1.3 to 1.35 per stage at limiting tip speeds for shrouded impellers of the backward bladed type. With high molecular weight gases like the refrigerant "F-12," a pressure ratio of slightly above 2.3 per stage is obtainable.

For uncooled machines, the overall ratio of compression is limited by discharge temperature. Practice undoubtedly varies, but about 400 F is the maximum discharge temperature permissible with ordinary construction. For higher pressure ratios, staging with intercooling is necessary.

Practically all types of common drive equipment may be applied, including high speed oil and gas engines.

The most efficient and simple control is obtained by varying compressor speed. Alternately, constant speed with suction or discharge throttling may be used. Some companies offer compressors with movable diffuser or impeller inlet guide vanes, but the mechanical complication and extra cost of such methods is seldom justifiable.

For either constant or variable speed operation, an attempt is usually made to operate above the surge point. However, if the machine is equipped with a discharge check valve or if the energy of the surge is limited by low gas density or small volume stored on the discharge, operation below the surge is feasible. At very low displacements (below about 15 per cent rating) with surging operation, the machine will overheat. This must be avoided.

Advantages of Centrifugal Machines

The principal advantages of centrifugal compressors may, of course, be found generously distributed among the sales literature of their various manufacturers. Nevertheless, I would not consider this paper complete if they were not presented again herein. In conclusion, let me list them for you:

1) A minimum of moving parts.

2) Almost complete freedom from mechanical wear.

3) Freedom from vibration; assuming, of course, the machine is originally well-balanced and the application does not result in an appreciable deposit of material or removal of material from the rotor.

4) Relative compactness.

5) Ability to deliver a variable displacement at approximately constant compression ratio when driven at constant speed.

6) Will not overload drive equipment if operated at constant speed with normal or subnormal suction density.

7) High, maintained efficiency.

8) Easily installed, no special foundation required.

RADIANT HEATING

Excerpts from a paper prepared by T. Napier Adlam, vice president, Sarco Co., Inc., for the Midwest Power Conference session on developments in space heating

IT IS generally understood that the human body requires no heat whatever from without, and that from the nutriment taken into the body, the wonderful process of nature's mechanism called metabolism, generates all the heat required and, in addition, generates a surplus amount of heat which has to be thrown away. The concept that warm ambient air is necessary to keep the body warm is fundamentally wrong. The only essential factor in dealing with heat for comfort and health is that surplus heat which we throw away. This is the fundamental basis on which the theory of "radiant heat" is built.

Roughly, 400 to 420 Btu surplus heat must be given off from the human body every hour. This amount of heat varies very considerably with posture, occupation, environment, age, and food. At about the age of six, the heat generated reaches its maximum, but in older persons the heat generated is much lower—which explains the reason elderly people need more protection from the cold than younger ones.

The figure of 410 Btu as the amount of heat which will be given off by the average person can be divided somewhat as follows: Radiation and convection, 300 Btu; evaporation, 62 Btu; and respiration, 45 Btu per hr, with a small amount of excreta. The radiation loss is that amount of heat given off from the body by heat rays, because the surface of the body is warmer than the surface of the surrounding walls, windows, ceiling, etc. The convection loss is the amount of heat given off from the body as the ambient air rises over the surface of the body and carries away the heat. The heat loss by evaporation is that amount of heat taken from the body as perspiration is evaporated from the skin, and the heat dissipated by respiration is the heat given to the air we breathe. While it is difficult to differentiate between radiation loss and the loss by convection, it is found that if the loss by radiation is maintained at about 190 Btu per hr and that by convection is 110 Btu per hr, a condition of greatest comfort and health is attained.

The human body can accommodate itself within certain limits, but if the conditions of the environment and the state of the body are not perfectly correlated, the person is vaguely conscious of a strain in the thermostatic body mechanism. This question of losing heat from the body is really a complicated process, because it seems very apparent that the feeling of hot and cold is not so much a measure of the heat loss to the heat generated as it is the way in which it is lost.

Sensation of Heat and Cold

Broadly speaking, the sensation of hot and cold can be avoided in two ways, either by temperature of the air being raised sufficiently high, or by warm surfaces placed in the walls, floor, and ceiling, so that the heat radiated is sufficiently intense to compensate for a lower air temperature. It must be clearly understood, however, that while some conditions stimulate the production of heat in the body, others merely dissipate the heat without in any way controlling the generation. This must never be overlooked in considering conditions of health as well as comfort. A thermometer recording the temperature of the air is no indication of the correct comfort conditions for the human body. This same conclusion applies to any instrument recording only the air temperature, whether it is based on the dry bulb or the wet bulb reading.

Consequently, the correct basis of true comfort must be sought elsewhere. No system can be really satisfactory which does not take care of the three main factors controlling the heat loss from the human body — radiation, convection, and evaporation. The greatest of these losses is that due to radiation and, consequently, it is the most important.

Everyone is familiar with the fact that when the surface of a body is illuminated for some time by rays of sunlight, the temperature of that body is raised. In other words, it becomes warmer because the heat energy from the sun is absorbed by the surface of the body.

It is also common knowledge that the condition of the surface plays an important part in relation to its rise of temperature. For instance, an object with a white, smooth surface does not become as hot as one with a dull, black surface. Hence, roofs and skylights of buildings are often painted white or are limewashed in the summer. For the same reason people in very hot climates customarily wear white coverings instead of dark.

One other thing that should be observed about heat rays is that they are reflected from a surface in exactly the same manner as light rays. Thus, we can obtain a strong parallel stream of heat rays from a parabolic reflector when a hot element is placed at the focus. This property of reflection enables us to reflect a stream of heat rays from one direction to another, the same as a beam of light with a mirror or other reflecting surface.

Mean Radiant Temperature

By neglecting the one factor of radiation loss from the human body, there are created a whole series of faults in our heating which are unhealthy and expensive. Therefore, for correct comfort and greatest economy, it is necessary to establish what conditions are necessary to take care of the heat losses from the human body and break away from many of the old-fashioned ideas formerly held. Since the first consideration is to take care of human radiation losses, it is necessary to maintain a mean radiant temperature in the room which will control the heat loss by radiation from the human body.

The mean radiant temperature of a room does not mean the average surface temperature of walls, windows, ceilings, etc., but the average amount of radiant heat emitted from all these surfaces. This is termed the mean radiant temperature, or MRT, of a room. To decide what this MRT shall be, it is necessary to know the mean surface temperature of the human body, including the clothes and exposed skin surface. In England this has been established at 75 F, but in America 81 F has been assumed by the author as giving results more nearly conforming to American conditions. Much, of course, depends on the clothes worn by the person and it will be easily understood that ladies in evening dress will offer a higher surface temperature than men dressed in conventional lounge or evening suits with only hands and head uncovered.

Contractors Issue Radiant Heating Bulletin

An engineering bulletin, Radiant Heating Design and Application, has been developed by the committee on standards of the Heating, Piping and Air Conditioning Contractors National Association with assistance and suggestions from Dr. F. E. Giesecke, Cyril Tasker, C. A. Hawk Jr., and Alexander Dzubay. This publication, consisting of design data, explanatory comments, and several example calculations, was prepared to acquaint members of the association with the fundamental theories and practical applications of this type of heating system. The information contained is derived from published data and practical experience and is not to be construed as a standard.

The basic principles of radiant heating, especially as they differ from the common types of convection heating, are briefly mentioned and the effect of the rate of body heat radiation, which may be brought about by maintaining warmer surface temperatures of surrounding walls, even in relatively cool air, is pointed out. Principles of application with respect to materials, pipe locations, control systems, expansion, venting, draining, heat transmission, and pipe spacing are briefly mentioned. Two methods for calculating ceiling panels and pipe sizes, etc., are given. These involve the use of a number of charts and tables which have been reprinted from the ASHVE Guide and from papers published in Heating, Piping & Air Conditioning.

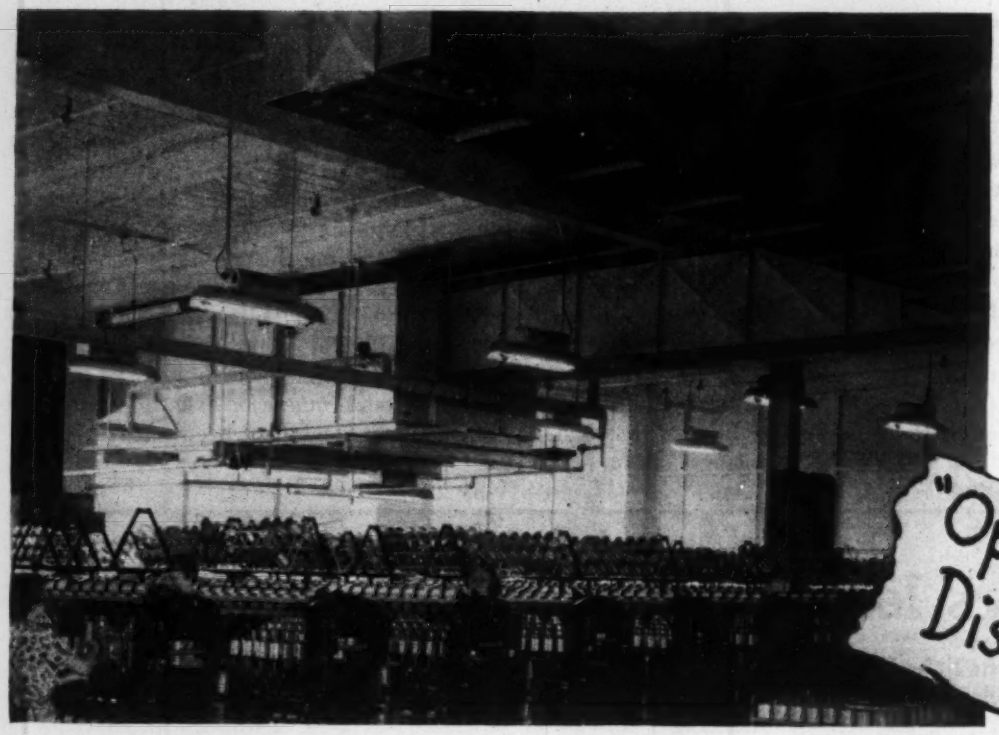
In the first method, given for the determination of ceiling panel data, a selection chart for finding the mean radiant temperature of the room is used. This is based on the assumed inside air temperature and the type of occupancy. Tables giving emissivity factors for various types of surfaces, the total radiation in Btu per sq ft per hr emitted to surroundings with a temperature of absolute zero by bodies at various temperatures and with various emissivity factors, and a table for determining unheated wall surface temperatures are given. The area of each unheated surface (including unheated ceiling), the corresponding emissivity factor, and the total radiation from each unheated surface to surroundings at absolute zero temperature are determined.

The heat emission from each unheated surface (including unheated ceiling) is then added. This sum represents the total radiation to surroundings at absolute zero by all unheated surfaces. From the tabulated data given and using an average emissivity factor for all the surfaces, the total radiation (to surrounding surfaces at zero absolute), which corresponds to the design mean radiant temperature, may be determined. The difference between this and the sum of the emissions by individual unheated surfaces equals the heat to be supplied by the radiant ceiling panel. Using a chart, which gives the heat dissipation per square foot in all directions for various mean water temperatures, and various combinations of pipe sizes and spacing, the next step is to assume a mean water temperature, calculate the necessary size of panel, and select the pipe size and spacing; or to select the panel size, solve for mean water temperature, and then choose pipe sizes and spacing.

A simplified alternate ceiling panel method is given which consists of finding the required heat emission per square foot of ceiling panel by dividing the room heat loss by the available ceiling panel area. In this method 90 per cent of the panel output is assumed to flow downward into the room and a chart giving various combinations of pipe sizes and spacing for various mean water temperatures and panel output is used to select the piping. This chart is based on 3.5 Btu per hr transfer per sq ft of pipe surface per deg temperature difference of water to 70 F air.

For floor type panels, according to the authors, "Experience has shown that the assumption of floor temperature is misleading for the surface temperature may remain constant with a considerable change in outside weather condition due to increased transfer caused by lowering of outside wall temperatures. Experience shows that in the case of floor type radiant heating, 60 to 80 Btu per sq ft per hr may be taken as safe figuring for residential and office buildings, using an average of 70 Btu per sq ft per hr." For this type of panel, pipe size and spacing are selected on this basis.

This 17 page, 8½x11 in., paper covered bulletin may be obtained from HPACCNA headquarters, 1250 Sixth Avenue, New York 20, or through any of the 31 local association offices. The price for non-members is $5.00.



"Controlled conditions"—including evaporative cooling—were installed in this North Carolina mill some years ago, and the system has recently been extended for increased plant production. The conditioning apparatus is in unitary form and is suspended from the ceiling

What Air Conditions Make for Comfort in Industry?

THE EDITOR—It is gratifying to receive such a thorough and thoughtful comment on my articles on factory air conditioning from a reader of the professional caliber of Walter L. Fleisher [see "Open for Discussion," page 114, February HPAC].

There is apparently, however, some misunderstanding on Mr. Fleisher's part as to what was intended to be accomplished by the "ideally designed ventilation system" referred to in the original articles. Mr. Fleisher states that "it is obvious that no 72 deg effective temperature can be obtained (or anything like that) with a 75 deg or higher outside wet bulb temperature." Also, he says: "When we speak of ideally designed ventilating systems capable of providing comfort to 75 per cent of moderately active workers, and these conditions can only be obtained with refrigeration, we certainly are opening all of our industrial establishments to a critical interpretation by labor that is not warranted, I believe, by the facts."

The misunderstanding has apparently arisen because Mr. Fleisher has inaccurately quoted my original definition of the "ideally designed ventilation system," which was defined to provide "comfort to 75 per cent of moderately active workers *for about one-half the summer daytime working hours.*" All of the economic comparisons in the original articles and later discussions were on this basis, and a simple calculation will show that refrigeration will not be required to conform with the requirements of this definition.

Mr. Fleisher also points out that the committee on air conditioning in industry was assigned to investigate what conditions were "safe or proper for people in industry," and he notes that "no particularly unfavorable reactions were noticed until a condition of about 87 deg effective temperature was reached with men mildly exercising," the conclusion finally being reached that "a 78 deg effective temperature, for people moving or standing, was considered comfortable by all of the subjects."

In reply, it should be stated that our previous reports have not been concerned with air conditions which were "safe" from a physiological standpoint, but rather with providing conditions which were *comfortable* to a certain percentage of workers for a certain portion of their working hours.

78 Deg Effective Temperature Not Comfortable

Perhaps the requirements have been made more difficult by the more recent aggressive attitude of the labor movement generally, but, Mr. Fleisher to the contrary notwithstanding, our day-to-day experience shows that modern workers do *not* relish working in atmospheres of 85 F DB and 52 per cent RH (which is the 78 deg effective temperature Mr. Fleisher advocates) and they do *not* consider these conditions "comfortable."

To us, the previously defined standard of comfort (75 per cent of workers comfortable for about half the summer daytime working hours) is not an unduly severe one. If it be accepted, the economic com-

parisons for both ventilation and evaporative cooling systems which have previously been published will inevitably apply. If Mr. Fleisher feels that such a standard is too severe and is willing on his projects to accept comfort for fewer people or for shorter portions of the working hours, the economic comparison will, of course, become more favorable to the systems not taking advantage of refrigeration effect.

To illustrate this point, if an evaporative cooling system be designed, as advocated by Mr. Fleisher, to circulate only the one-third greater air quantities than those required for complete air conditioning, the resulting conditions in the space, on an average summer day in New York City, would calculate to the 78 deg effective temperature as stated by Mr. Fleisher. However, the comfort charts show that no office or light factory workers would be comfortable on this average day, although there would be other days (totalling considerably less than half the summer daytime working hours) on which some of the workers would be comfortable. Conversely, no one would be comfortable for half or more of the summer daytime working hours.

Navy Efficiency-Work Tests

Mr. Fleisher's reference to the efficiency-work tests performed at the instance of the Navy Department was of particular interest. I presume that he refers to the very excellent paper by M. S. Viteles and K. R. Smith, presented at the annual meeting of the ASHVE in January of this year. It does not seem to the writer that the conclusions of that report bear in any important way upon the present discussion, since it dealt primarily with the effect of high effective temperatures and noise upon worker efficiency and physiological response of the subjects, and our original reports specifically disclaimed improvement in worker efficiency as a factor "favoring installation of air conditioning in all cases."

By way of comment, however, we have been wondering whether the degree of motivation on these tests was not unduly high [bonus wages, team competitions, the "thrill" and patriotic appeal of important wartime research, and the short (4 hr) test day], and that the only justifiable conclusion was that the assigned tasks were possible of accomplishment with sufficiently high incentive. It is certainly questionable whether a similar high degree of incentive could be maintained, on routine production jobs, by industry generally. It would be interesting to hear the opinions of others on this important question. —H. A. MOSHER, mechanical engineer, Kodak Park Works, Eastman Kodak Co.

Use Floor, Wall or Ceiling Coils for Radiant Heating?

THE EDITOR—I have read F. W. Hutchinson's article [in the March HPAC] on how to choose the proper location for heating panels used in radiant heating systems very carefully and would like to comment on it.

Primary Purpose of Heating System

First of all, I should like to preface my comments by saying that there is no questioning the scientific competency with which the work has been carried out in preparation for this article. However, many people interested in radiant heating work today seek guidance on the practical application of the basic principles and this requires a more comprehensive study of the economics of the installation, the structural characteristics of the building, and a somewhat complex array of physiological and psychological considerations. For this reason, those of us who earn our living in radiant heating work have come to feel that a purely mathematical approach is only part of the story.

The primary purpose in installing a heating system in a building is to create comfort, insofar as human occupancy is concerned. To attach overriding emphasis to finely drawn differences in heat transmission channels from one variation of the same basic system to another seems to be unsound, provided that comfort conditions are substantially the same in both cases.

Having worked closely with thousands of owners and occupants making use of both floor and ceiling types of radiant heating systems, we have failed to find any difference in their reactions. This is particularly true in the case of structures which involve both floor and ceiling coils in different rooms—the occupants can't tell the difference, because in a properly designed system—floor or ceiling—there is no indication of the source of heat.

Perhaps the reason for this uniform reaction lies in the fact that the mathematical analysis of just how heat is transmitted away from the heating panel ignores rather completely certain phases of the human comfort problem. Consequently, while there is no gainsaying the fact that convection transmission is greater from a floor panel at the same temperature as a ceiling panel, the rather stubborn geometric fact remains that the occupant is at all times closer to the floor than the ceiling and is, therefore, more readily affected, in a radiating sense, by the temperature of the floor. Whether or not this compensating characteristic is the reason for the identical comfort conditions experienced from floor and ceiling coils can only be determined through additional intensive study. However, such a study would seem to be rather academic in view of practical experience.

Floor Coils Can Usually Handle Load

On one point which is basic to the development of Professor Hutchinson's analysis, experience is at considerable variance. That is the point which implies that floor type radiant heating systems are incapable of handling a sizable portion of room heating loads. Up until perhaps three years ago we also adhered closely to this premise, but an increasing number of what might be termed "freak" installations demonstrated that it is almost impossible to conceive of a heating load intensity which cannot be handled by floor coils alone. It would be my estimate that such rooms would constitute only a very small fraction of 1 per cent of all rooms which any designer is likely to encounter. Consistent experience in many hundreds of installations

within the past three years bears out this contention.

In making these comments it is not my intention to create the impression that a floor type radiant heating system is to be desired over a ceiling type installation. Far from it. I have merely sought to make the point that a floor type system is not relatively uncomfortable and limited—as a purely theoretical approach might lead one to believe. Instead, for practical purposes the designer is free to choose either a floor or ceiling heating panel (except for concrete slabs on the ground) with the determining emphasis being placed on installation cost and structural characteristics. In some cases, taking these things into consideration, the floor panel will be a clear-cut winner, while in others the ceiling panel will emerge as the proper choice.—C. A. HAWK, JR., manager, radiant heating department, A. M. Byers Co.

THE EDITOR—The coefficients that F. W. Hutchinson has given in his article in the March HPAC should be welcomed by designers of radiant panel heating systems who wish to use more than one heated panel in rooms in which sufficient heated area is not available in one panel.

Clear and Simple Explanation

No reference is made in the article, however, to the resulting effect of heated panels that are adjacent or opposite each other in the same room. We venture the opinion that in such cases it might be preferable to make provisions for reducing heat losses to a point where a heated panel in but one location would suffice. Furthermore, if calculations and space conditions indicate that heated panels are required in more than one enclosing surface of a room, one might properly assume that the room could be heated more economically by conventional methods, despite the common opinion that radiant panel heating is suitable for any job.

The clear and simple explanation of the relative energy dissipation from heated panels in various locations should be helpful to many readers. If this information could have wide enough publicity it might tend to correct the erroneous impressions that have been created in the mind of the general public by a vast amount of illustrated advertising recommending floor panels. Such recommendations seem to be based more on the character and limitations of the piping used for the coils than on sound engineering.—D. L. MILLS, Revere Copper and Brass, Inc.

MANAGEMENT IS INTERESTED IN AIR CONDITIONED FACTORY

THE EDITOR—Our management is quite interested in the use of air conditioning in factory space and I have been asked to determine as well as possible the dollars and cents advantage, if any, of applying air conditioning to manufacturing plants.

I am especially interested in finding out what effect air conditioning has on output of labor, effect on morale, and employees' health, etc.

We can determine fairly accurately the cost of installing and operating air conditioning equipment, but the factors mentioned above are things with which I have had no experience and I thought that possibly some articles might have been written covering these items. If you have published any such articles or know of any papers or articles which might have been written covering the above subject, I would appreciate it very much if you would advise me so that I can look it up in our library or, if you have any reprints on the subject, I would be very happy to obtain copies.—L. G. G., engineering department.

[*In reply to L. G. G.'s question, copies of a number of articles from back issues have been mailed him, including Report from Industry: Should Factories Be Air Conditioned? by R. D. Tutt, W. E. Goohs, and F. G. Tykle, from the January* 1945 *number, and When Is Complete Air Conditioning of the Modern Factory Advisable? by H. A. Mosher, published in two parts in the June and July* 1945 *issues of HPAC.—Editor.*]

ENGINEER ASKS FOR REFERENCES TO SMOKE ARTICLES

THE EDITOR—We have read with interest the article on smoke elimination by Raymond R. Tucker published in the October-November 1945 issue of Heating, Piping & Air Conditioning. We would like to know where we can procure a copy of the first article by Professor Tucker and if the third article has come off the press yet.

Also, we would like to know of any other articles on smoke elimination that you would suggest that we should read, as we are vitally interested in this subject.—R. C. S., engineer.

[*The series of articles by Professor Tucker, formerly smoke commissioner of St. Louis, was published in five installments in the September, October-November, and December* 1945, *and the January and February* 1946 *issues of HPAC. The title of each part was A Smoke Elimination Program That Works, and many requests for extra copies and comments on the information given have been received. It is planned to prepare reprints.—Editor.*]

APPROVES SIMPLIFIED BRONZE OR BRASS VALVES

The standing committee in charge of reviewing and revising simplified practice recommendation R183-42, bronze or brass valves, has approved a revision of the recommendation, and the division of simplified practice of the National Bureau of Standards, Washington 25, D. C., has mailed out copies for approval or comment or both.

The original recommendation became effective January 1, 1942, and subsequently served as the basis for mandatory orders issued by the War Production Board. Following revocation of the final of these orders, the standing committee, in cooperation with the division of simplified practice, drafted a revision, the purpose of which is to retain the essential purpose of the original recommendation and include those features of the wartime order which the industry found to be of benefit to producers, distributors, and users.

The proposed revision applies to gate, globe, angle, and check valves made of bronze or brass for primary pressures ranging from 100 to 350 psi, and 1000 to 2000 psi for water, oil, and gas. A simplified range of sizes is given for the various types and kinds of valves for each of the pressure ratings.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

The Influence of an Interior Coating of Aluminum Paper on Internal Thermal Conditions and Heat Economy

R. J. Lorenzi,* L. P. Herrington,** and C.-E. A. Winslow†
New Haven, Conn.

SUMMARY—A lining of reflective-insulation (aluminum foil on kraft paper) applied to walls and ceiling of a brick walled test room reduced the radiant heat transfer to the surfaces with consequent lowering of inside wall surface 4 to 5 deg below the corresponding temperatures of brick walls. The response to heating and cooling was more rapid, there was a reduction in the overall coefficient of heat transfer and a saving of 20 per cent in heat required to maintain comparable room conditions. Night cooling during 8 hours, permitting room temperature to fall to 50 F, effected a saving of 33 per cent of the heat required to maintain 70 F continuously in the absence of aluminum.

Object and Nature of Experiments

In an earlier contribution[1] there was reported a comparison of internal thermal conditions and heat economy in two experimental rooms, one of brick and one of ordinary frame construction. The present paper relates to a study made of the brick room, used in the earlier experiment, after covering the lower surface of its ceiling and the interior surface of its walls with a commercial aluminum product consisting of aluminum foil mounted on one side of kraft paper. The thermocouples on the aluminum surface were separated from that surface by cellulose tape to prevent electrical transfer to the metallized surface. The thermocouples were held in place by an additional layer of cellulose tape placed over the junction. In all other respects, the experiments were identical with those made previously with the plaster walls of the same room. It is, therefore, unnecessary to report the structural and operating details given fully in our earlier contribution.

The room was 15x12x8 ft high. Its north, west and south walls faced exterior cooled shell spaces, with two windows on the long west wall and one on the short south wall. The east wall faced an interior space.

Comparable experiments were made under three conditions:

A. With a continuous external temperature of 20 F; interior of room maintained at 70 F for a preliminary stable period; heating lamps turned off for 8 hours, to represent a period of night cooling; after which the interior of the room was rapidly heated up to normal again. (Experiments B-II and B-Al-II, without and with aluminum, respectively.)

B. The same experiment, except that during the period of night cooling the lower sash of the south window of the room was raised 8 in. and the upper sash of the northerly window on the west wall was lowered 8 in. (Experiments B-VII and B-Al-VII.)

C. The same as described under (A), except that instead of a constant exterior temperature of 20 F, the external temperature was cycled between 10 F and 30 F, to represent a diurnal cycle, the period of night cooling coming at the low point of the external cycle. (Experiments B-III and B-Al-III.)

The results of B-VII and B-Al-VII and of B-III and B-Al-III, are shown graphically in Figs. 1 and 2. In each case, the night cooling cycle was repeated twice.

Fig. 1 (for the experiments with constant 20 F temperature outside

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†Director, John B. Pierce Laboratory of Hygiene, Member of ASHVE.
[1]The Influence of Heat Capacity of Walls on Interior Thermal Conditions and Heat Economy, by C.-E. A. Winslow, L. P. Herrington and R. J. Lorenzi. (Journal Section, *Heating, Piping & Air Conditioning*, April, 1945, p. 207.)
For presentation at the Semi-Annual Meeting of the American Society of Heating and Ventilating Engineers, Montreal, Que., Canada, June, 1946.

and night cooling with windows open) shows that the external air was nearly the same in the two experiments compared, although a little over 1 deg lower in B-Al-VII. The mean globe temperature during the stable phase was about 1.5 deg higher in B-Al-VII. These were, of course, differences due to the experimental set-up.

The very much higher temperatures for B-Al-VII at the lower ceiling and the much lower temperature at the center of the brick wall were, on the other hand, characteristic results of the use of the aluminum insulation. These differences will be discussed in detail in later paragraphs.

Similar results for the experiments with cycling outdoor temperature are shown in Fig. 2 for Experiments B-III and B-Al-III. In this case, the mean globe temperature during the stable phases was about 3 deg higher in B-Al-III than in B-III. This was due to experimental procedure. The higher ceiling temperature and the lower wall temperature for the aluminum experiments are similar to those reviewed in the foregoing.

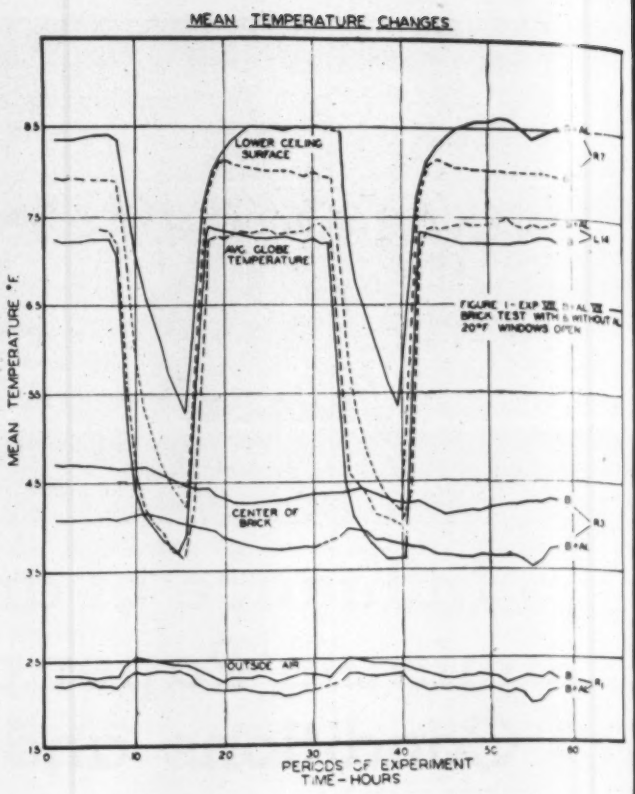

Fig. 1 Mean temperature changes during tests conducted with continuous 20 F external temperature.

Comparison of Temperature Conditions Maintained With and Without Aluminum Insulation During Stable Phase

The mean stable phase temperatures of the outside environment for the six experiments are summarized in Table 1. Similar data for the interior temperatures of the room are given in Table 2.

It is apparent from these tables that some variation between the six experiments did occur at some points. However, these differences which were due to limitations in experimental control can, in reasonable degree, be eliminated by averaging the three experiments for each structure, although the aluminum series is slightly weighted by higher figures for B-Al-VII.

A comparison of mean results is made in Table 3, with the data arranged according to the flow of heat through the five surfaces involved.

Table 3 brings out the true characteristics of the aluminum insulation. The outside air in the aluminum experiments averaged 1.3 deg lower than in the brick series. This was due to basic control conditions, independent of the insulating effect. But the fact that the outside surface of the exterior walls was 2.8 deg lower and their inside surfaces 4.5 deg lower is highly significant. There were no significant differences in the window temperatures, or in the temperatures above the ceiling, or below the floor, or in the space outside the interior east wall.

The lower ceiling surface was 5.7 deg higher with the aluminum wall and the upper floor surface (due to reflection from the ceiling) was 2.2 deg higher. The higher ceiling surface temperature was due to the stratification of warm air at the ceiling caused by a reduced film coefficient. So far as the net influ-

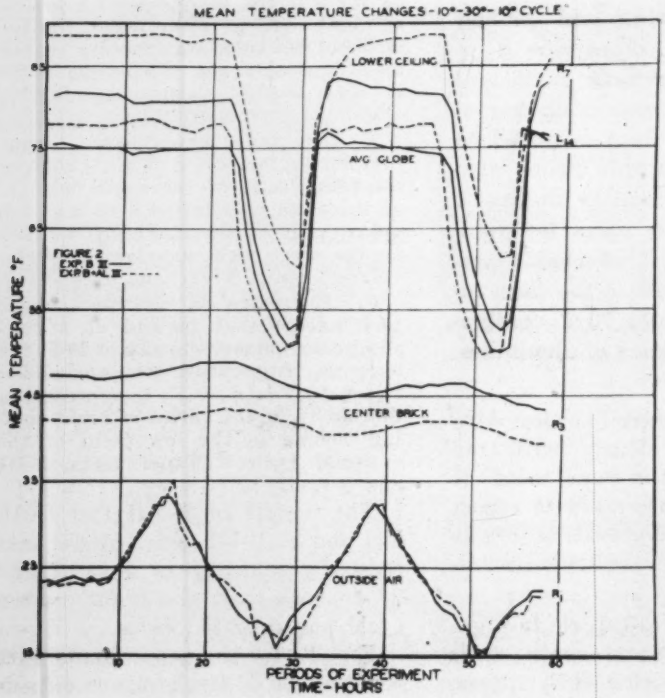

Fig. 2 Mean temperature changes during tests conducted with 10 F -30 F-10 F temperature cycles.

Table 1—Mean Stable Phase Temperatures of External Environment

	Preliminary Stable Phase					
	Brick			Brick—Aluminum		
	Exp. II	Exp. III	Exp. VII	Exp. II	Exp. III	Exp. VII
Mean Air Outside, 3 Exterior Walls	21.9	20.6	21.9	20.6	19.8	20.3
Mean of Outside Surface, 3 Exterior Walls	29.7	29.3	29.3	26.7	27.0	26.2
Outside Surface, Windows	34.6	34.2	34.0	33.3	34.8	33.1
Air Above Ceiling	49.2	49.4	50.1	48.2	51.1	48.6
Upper Ceiling Surface	50.7	51.0	51.8	51.0	53.0	50.8
Air Below Floor	49.5	49.4	51.8	48.8	50.4	51.6
Lower Floor Surface	50.8	51.0	53.0	50.9	51.7	53.2
Air Outside East Interior Wall	60.8	63.5	66.2	62.3	63.1	64.6
Outside Surface, East Interior Wall	59.0	61.3	64.4	61.3	63.4	65.8

Table 2—Mean Stable Phase Temperatures of Interior of Room

	Preliminary Stable Phase					
	Brick			Brick—Aluminum		
	Exp. II	Exp. III	Exp. VII	Exp. II	Exp. III	Exp. VII
Inside Surface, Windows	60.0	60.4	58.8	60.2	61.4	58.5
Mean of Inside Surface of 3 Exterior Walls	61.8	61.5	60.7	56.7	58.6	55.0
Upper Floor Surface	72.6	73.5	71.0	75.1	76.1	72.5
Inside Surface, East Interior Wall	73.4	73.7	71.9	72.0	73.2	70.0
Mean Room Air	74.1	73.7	71.6	72.9	74.5	70.0
Mean Globe	75.6	75.2	72.3	76.1	77.8	73.0
Lower Ceiling Surface	80.9	81.4	79.1	86.4	88.5	83.7

Table 3—Stable Phase Temperatures Recorded at Various Points (Mean of B-II, B-III and B-VII, Compared with Mean of B-Al-II, B-Al-III and B-Al-VII

	Brick	Aluminum	Deviation of Aluminum
Outside Air	21.5	20.2	—1.3
Outside Wall Surface	29.4	26.6	—2.8
Inside Wall Surface	61.3	56.8	—4.5
Mean Air	73.1	72.5	—0.6
Mean Globe	74.4	75.6	+1.2
Outside Window Surface	34.3	33.7	—0.6
Inside Window Surface	60.0	59.7	—0.3
Air Above Ceiling	49.6	49.3	—0.3
Upper Ceiling Surface	51.2	51.6	+0.4
Lower Ceiling Surface	80.5	86.2	+5.7
Air Below Floor	50.2	50.3	+0.1
Lower Floor Surface	51.6	51.9	+0.3
Upper Floor Surface	72.4	74.6	+2.2
Air Outside East Wall	63.5	63.3	—0.2
Outside Surface, East Wall	61.6	63.5	+1.9
Inside Surface, East Wall	73.0	71.7	—1.3

Table 4—Minimum Temperatures Reached Inside Room During First Cooling Phase

	Expt. II		Expt. III		Expt. VII	
	B-II	B-Al-II	B-III	B-Al-III	B-VII	B-Al-VII
Inside Window Surface	42.9	42.6	41.3	41.0	34.2	32.6
Inside Surface West Wall	50.7	46.1	50.4	47.0	43.3	40.0
Inside Surface, South Wall	50.6	46.2	50.4	47.4	43.0	40.4
Inside Surface, North Wall	50.2	46.4	50.2	47.6	42.6	40.3
Upper Floor Surface	51.9	51.8	52.1	51.4	39.2	40.9
Inside Surface, East Wall	52.7	52.8	52.4	52.9	40.8	41.2
Mean Air	51.6	50.9	50.8	50.2	35.8	36.6
Mean Globe	51.6	50.8	50.9	50.3	36.9	36.7
Lower Ceiling Surface	52.7	60.8	52.9	60.4	42.3	52.8

ence of radiation and convection was concerned, the mean air temperature of the aluminum room was 0.6 deg lower than that of the brick room and its mean globe temperature was 1.2 deg higher.

Temperatures Attained During Cooling Phase With and Without Aluminum Insulation

The minimum temperatures attained during the cooling phase are indicated in Table 4.

It will be noted that results for Experiments B-II and B-III were practically identical, and that results for B-Al-II and B-Al-III were practically identical with each other, although wall surfaces were 2.3 deg—4.6 deg lower than without the aluminum insulation and the lower ceiling, 7.5 deg—10.5 deg higher.

Experiments B-VII and B-Al-VII, with the windows open, showed, of course, lower minimum temperatures than B-II, B-III, B-Al-II and B-Al-III because of the open windows. The processes of cooling and reheating were much more rapid in the case of the aluminum wall as indicated in Table 5 (with the exception of the cooling phase in the open window tests).

Stable Phase Temperatures on a Gradient Through North Wall With and Without Aluminum Insulation

In addition to the data reported, 6 thermocouple records were obtained at the following points, giving a gradient through the north wall; inside air 4 in. from the center of the wall; inside surface at center of the wall; contact between interior plaster and brick; center of the brick wall; exterior surface of the brick wall; air 4 in. out from the exterior brick surface.

Table 5—Rates of Cooling and Reheating of Brick and Aluminum Surfaced Rooms

Fall of Globe Temperature in First 2 Hours of Cooling

Expt.	II	III	VII
B	11.7	10.1	26.3
B-Al	17.3	17.1	26.3

Rise in Globe Temperature in First 30 Minutes of Reheating

Expt.	II	III	VII
B	20.0	18.8	26.0
B-Al	27.0	27.8	32.5

Mean temperatures at these six points for the six experiments, during the preliminary stable period, are summarized in Table 6.

In general, the results for the brick series check each other as do the results for the brick-aluminum series. Experiments B-VII and B-Al-VII both had low inside air temperatures which were reflected in low temperatures at the inside surface and the brick-plaster contact. In Experiment B-Al-III these three points showed high temperatures as a result of warmer inside air.

The data are sufficiently comparable to warrant averaging within each series. Using this combined average, the brick aluminum wall shows an outside air temperature 0.6 deg lower; outside surface temperature 3.5 deg lower; center of brick temperature 5.4 deg lower; brick-plaster contact temperature 8.1 deg lower; inside surface temperature 4.8 deg lower; and inside air temperature 0.5 deg lower than the uninsulated brick wall. The general influence of the aluminum insulation is apparent.

Since the temperature differentials between brick-plaster contact and inside surface in the aluminum series appeared to be greater than we had anticipated, we were led to suspect that the inside surface temperatures as recorded might be too high, due to reflective effects upon the surface thermocouples. Special studies reported in a later paragraph confirmed the view that our readings on the aluminum wall surfaces were about 2.2 deg too high. Thus, in Table 6, the inside surfaces should be, respectively, 56.1 deg, 58.6 deg and 54.5 deg for Experiments B-Al-II, B-Al-III, and B-Al-VII and the average should be 56.4 deg.

Influence of Aluminum Insulation on Wall Conductance

For the determination of the influence of the aluminum insulation upon wall conductance, a special experiment, B-Al-V, was conducted. In this experiment, the shell space outside the north wall was kept at 15 deg and the other three shell spaces, the spaces above the ceiling and below the floor and the interior of the room itself, were all maintained at about 90 deg. The actual mean values at various points in the room and its environment varied from 85.5 deg on the outside surface of the west wall to 90.4 deg on the inside of the east wall, except that the lower ceiling surface was 96.5 deg. The mean inside air temperature was 89.5 deg, and the mean globe temperature was 90.8 deg. These conditions were essentially identical with those obtained in a similar experiment, B-V, before the aluminum coating was applied.

The temperature differentials between successive points on the gradient through the north wall were as follows for the two experiments:

	Without Aluminum	With Aluminum
Inside Air—		
Inside Surface	13.8	16.8
Inside Surface—		
Brick-Plaster Contact	1.6	7.1
Brick-Plaster Contact—		
Center of Brick.....	23.3	20.1
Center of Brick—		
Outside Surface ...	20.1	16.6
Outside Surface—		
Outside Air	14.8	11.0

These results correspond to those obtained (under less extreme conditions) in Experiments B-Al-II, B-Al-III and B-Al-VII. Again, the very great drop between the inside surface and the brick-plaster contact is not reasonable. The surface thermocouple temperatures as recorded on the aluminum walls and ceiling and on the floor were, therefore, checked by thermopile readings with the following results:

	Thermocouple Temperatures	Thermopile Temperatures
North Wall	67.0	91.4
West Wall	87.5	91.7
South Wall	88.0	91.1
East Wall	90.5	91.2
Lower Ceiling	96.5	89.9
Upper Floor	89.0	89.1

On the floor, which is nonreflective, the results checked, and on the lower ceiling the thermocouple reading was 6.6 deg higher than that of the thermopile. In the latter case, the higher thermocouple reading was probably influenced by the accumulation of warm air below the ceiling surface. In the case of the west, south and east walls, on the other hand, the thermocouple temperatures were lower than the thermopile temperatures by 4.2 deg, 3.1 deg and 0.7 deg, respectively. In the case of the cold north wall, the thermocouple figure was 24.4 deg lower than the thermopile temperature. The thermopile temperatures are, of course, significant with respect to the radiant effect of the surfaces. The thermocouple temperatures, on the other hand, should indicate heat loss from the surface to the exterior. The possibility remains, however, that the recorded thermocouple temperatures were somewhat higher than they should be on account of direct radiative effects of other aluminum surfaces on the couple itself. We tested this point by protecting the thermocouple on the north wall by a 12 in.x12 in. aluminum shield placed 0.5 in. from the walls. The thermopile temperature of the north wall in this case was 74.0 deg. The thermocouple read 54.8 deg without the shield and 52.8 deg with the shield. We, therefore, concluded that the aluminum foil surface temperatures as recorded were about 2 deg too high. A more complete analysis of this question will be offered in a succeeding paragraph.

The major purpose of Experiment B-Al-V was to determine the heat conductance of the aluminum covered wall. The mean heat input into the room for the stable condition was 687 watts, or 2336 Btu per hour. By using GUIDE coefficients for inside air to outside air, we computed a loss of 139 Btu through the ceiling, a gain of 6 Btu through the east wall, a loss of 28 Btu through the windows, a loss of 49 Btu through the floor, a loss of 66 Btu for the west wall and a loss of 13 Btu through the south wall. The balance (2336 — 289) was 2047 Btu passing through the north wall. This gives an air-to-air coefficient of 0.23 Btu per (hr) (sq ft) (F deg) for the aluminum covered north wall, identical with the theoretically assumed coefficient for the west and south walls. This figure compares with a figure of 0.29 previously determined for the same wall without aluminum. In all cases, as noted in an earlier paper, computations were made on the assumption of a total surface area

Table 6—Mean Temperatures at Various Points on a Gradient Through North Wall

	Preliminary Stable Phase							
	Brick				Brick-Aluminum			
	Exp. II	Exp. III	Exp. VII	Avg.	Exp. II	Exp. III	Exp. VII	Avg.
Outside Air	22.5	23.0	23.2	22.9	21.6	22.8	22.4	22.3
Outside Surface	33.0	33.8	33.4	33.4	29.6	30.6	29.6	29.9
Center of Brick	46.2	47.2	46.8	46.7	41.0	42.0	40.8	41.3
Brick-Plaster Contact	61.5	62.5	61.3	61.8	53.2	56.1	51.9	53.7
Inside Surface	63.5	64.3	62.5	63.4	58.3	60.8	56.7	58.6
Inside Air	71.8	71.8	69.9	71.2	70.2	73.5	68.5	70.7

midway between internal and exterior surfaces.

The surface-to-surface coefficient for the aluminum covered wall, determined from the thermocouples as installed, was 0.40 Btu per (hr) (sq ft) (F deg), as compared with 0.44 for the wall before the aluminum insulation was added, which is obviously too great a difference. Knowing the actual flow of heat through the north wall [air-to-air, 17.0 Btu per (hr) (sq ft)], we computed the flow between each of the succeeding gradient points through the wall and found that the individual figures checked the total overall figure reasonably well, except for the flow from inside surface to brick-plaster contact, which was 24.8 Btu per (hr) (sq ft). This confirmed our conclusion that the inside surface temperature was about 2.0 deg too high. By trial and error we found that if the recorded inside surface temperature be considered 2.2 deg too high, the flow between successive points on the gradient is entirely reasonable. On this assumption, the flow from inside air to inside surface was 17.4 Btu per (hr) (sq ft); that for inside surface to brick-plaster contact was 17.1; and that for brick-plaster contact to center of brick was 16.6 Btu. Using inside surface temperatures 2.2 deg below those recorded, the overall surface-to-surface coefficient with aluminum works out to 0.43 Btu per (hr) (sq ft) (F deg) as compared with 0.44 for the original brick wall. The added obstacle to conductance introduced by the aluminum foil with its paper backing was very low. Its conductance was estimated as 10 Btu per (hr) (sq ft) (F deg).

The effect of the aluminum foil is primarily to reduce inside film coefficients by a reduction in heat transfer to the wall surface due to its reflective capacity. Comparing B-V and B-Al-V, we find that while the air-to-air overall temperature differentials and the surface-to-surface coefficients are practically the same in the two experiments, the air-to-air coefficient is reduced by 20.7 per cent, the actual decrease in required power input being 20.8 per cent, as indicated in the following:

	Air-to-Air Coefficient, Btu per (hr) (sq ft) (F)	Actual Btu Required to Heat Room
Expt. B-V	0.29	2951
Expt. B-Al-V	0.23	2336
Difference	0.06	615
Per cent reduction	20.7	20.8

Determination of the Inside Film Coefficient

Using the data of Experiment B-Al-V, it was possible to determine an inside film coefficient for the aluminum covered vertical surfaces by means of three methods. In Methods I and II the total amount of heat transferred per hour through the three exposed walls (north, west and south) was obtained by deducting the heat lost from all other surfaces from the total stable period heat input.

In Method I, by using the inside surface area of the exposed walls and the proper temperature differentials, it was possible to calculate two conductance values, one on the basis of inside surface to outside surface U_{s-s}, and the other on the basis of inside air to outside surface U_{a-s}. By then employing the following formula,

$$\frac{1}{U_{a-s}} = \frac{1}{f_i} + \frac{1}{U_{s-s}},$$

f_i, the inside film coefficient, was found to be 0.73 Btu per (hr) (sq ft) (F deg).

In Method II, two other conductance values were obtained, one on the basis of inside air to outside air U_{a-a}, and the other on the basis of inside surface to outside air U_{s-a}. By using a formula similar to that employed for Method I, f_i was again determined to be 0.73 Btu per (hr) (sq ft) (F deg).

In Method III, the radiant transfer and the convective transfer were determined separately and then combined. Using the well known Stefan-Boltzmann Equation

$$q_r = A e_{eff} \sigma \ (T_1^4 - T_2^4),$$

in which

q_r = the net rate of heat radiation,
A = the area,
e_{eff} = the effective emissivity,
σ = Stefan's constant,
T_1 & T_2 = the absolute temperatures,

q_r was determined to be 0.702 Btu per (hr) (sq ft), or 0.028 Btu per (hr) (sq ft) (F deg)

Table 7—Summary of Actual Power Requirements

BRICK STRUCTURE	20F		10-30F	
	B-II	B-Al-II	B-III	B-Al-III
1. General Conditions				
2. Experiment Number				
3. Hours, Stable Phase	1–10	1–12	1–7	1–9
4. Mean Watts, Stable Phase	2269	1799	2256	1870
5. Mean Inside Air, Stable Phase	74.1	72.9	73.8	74.5
6. Mean Outside Air, Stable Phase	21.9	20.6	20.7	19.8
7. Temperature Differential	52.2	52.3	53.1	54.7
8. Watts per deg F Differential	43.4	34.4	42.5	34.2
9. Hours, Heating Phase and Second Stable Phase	19–44	21–39	30–45	31–44
10. Total Watt Hours, Heating Phase and Second Stable Phase	68867	40090	43728	31570
11. Mean Inside Air Temperature Heating and Second Stable Phase	74.4	72.5	72.4	73.0
12. Mean Outside Air Temperature, Heating and Second Stable Phase	21.6	21.3	23.8	24.4
13. Temperature Differential	52.8	51.2	48.6	48.6
14. Theoretical Watt Hours, Heating and Second Stable Phase	59580	33464	33048	23270
15. Excess Watts to Satisfy Heat Capacity (10-14)	9287	6626	10680	8300

The film coefficient for convective transfer was then determined from data of Wilkes and Peterson,[2] and was found to be 0.755 Btu per (hr) (sq ft) (F deg), which gave a combined film coefficient of 0.78 Btu per (hr) (sq ft) (F deg).

The average of the three methods gave a combined film coefficient of 0.75, which checks nicely with the present GUIDE value of 0.74 Btu per (hr) (sq ft) (F deg), for a surface of 0.05 emissivity.

Influence of Aluminum Insulation on Heating Economy

On the basis of Experiments B-Al-II and B-Al-III, a computation was made of the economy effected by night cooling as compared with the results previously reported for Experiments B-II and B-III. Tables 7 and 8 are comparable to those previously presented and an explanation of the method by which the computations were made will be found in an earlier communication.[3]

It will be noted that the addition of the aluminum coating, in addition to obtaining the 21 per cent reduction in heating requirements during a stable state, also increased the additional saving due to night cooling. For comparable conditions, inside and out, the actual percentage heating load would be as follows, with and without aluminum:

	Without Aluminum		With Aluminum	
	B-II	B-III	B-Al-II	B-Al-III
Without Night Cooling	100	100	79	79
With Night Cooling	86	85	67	66

Influence of Aluminum Insulation on Summer Comfort Conditions

As in earlier experiments, without aluminum insulation, the authors conducted one experiment (B-Al-VI) covering a series of three diurnal cycles, in which no heat was supplied to the room, but in which the temperatures of the shell spaces outside the three exterior walls were varied between 65 F and 95 F. The space below the floor was kept at about 50 F, and the interior of the room, the space above the ceiling and that outside the interior east wall were allowed to drift. The results were essentially the same as those presented in our earlier paper for the brick wall without insulation.

The brick wall provided great protection against the daytime heat. While the outside air ranged from 65.0 F to 93.2 F in Experiment B-VI, and from 64.1 F to 94.1 F in Experiment B-Al-VI, the inside air varied only between 72.5 F and 73.8 F in Experiment B-VI and from 71.4 F to 73.2 F in Experiment B-Al-VI. The aluminum insulated wall showed a maximum outside air temperature 0.9 deg higher than that for the uninsulated room, and a maximum inside air temperature 0.6 deg lower than that for the uninsulated room, a very minor advantage in favor of the aluminum room.

Table 8—Estimate of Saving by Night Cooling

BRICK STRUCTURE

	B-II	B-Al-II	B-III	B-Al-III
1. Experiment Number and General Conditions	20 F	20 F	10–30 F	10–30 F
2. 24 Hour Differential	50 F	50 F	50 F	50 F
3. Total Watt Hours, without Night Cooling	52080	41280	51000	41040
4. Temperature Differential Stable Phase	50 F	50 F	46.5 F	46.5 F
5. Total Watt Hours, Stable Phase, (16 Hours)	34720	27520	31620	25445
6. Excess Watt Hours, Cooling Phase	990	720	1040	787
7. Excess Watt Hours, Heating Phase	9287	6626	10680	8300
8. Sum of 5, 6 and 7	44997	34866	43340	34532
9. Per Cent Saving by Night Cooling	13.6	15.5	15.0	15.9

General Conclusions

1. The primary effect of adding aluminum foil insulation to the walls and ceiling of the brick test room was to reduce the inside film coefficients. This was due to the reflective capacity of the foil and resulted in a reduction in radiant heat transfer at the surfaces.

The temperatures of the interior surfaces of the exposed walls were 4 to 5 deg lower, and the temperature of the lower ceiling surface was 5 to 6 deg higher with the reflective paper. The mean air temperature was 0.6 deg lower and the mean globe temperature was 1.2 deg higher in the insulated room than in the uninsulated room.

2. The response to heating or cooling was much more rapid in the insulated room.

3. The addition of the aluminum insulation lowered the coefficient of heat transfer from inside air to outside air from 0.29 Btu per (hr) (sq ft) (deg F) to 0.23. This reduction of 20.7 per cent was reflected in an actual reduction of 20.8 per cent in the heat necessary to maintain comparable conditions.

4. Furthermore, the percentage saving of heat input permitted by an 8 hour period of night cooling was increased by the aluminum insulation. Where 100 units of heat input were necessary with the uninsulated wall, kept continuously at 70 F for 24 hours, only 66 to 67 units were needed to keep the insulated room at 70 F for 16 hours, allowing it to fall to a minimum of 50 F during an 8 hour phase of night cooling.

5. Attention is called to the fact that, when working with surfaces of high heat reflectivity, the thermopile yields results which may be many degrees higher than the actual surface temperature which governs heat transmission outward through the wall. On the other hand, thermocouples on the surface of such a wall may yield values slightly higher than the true temperatures, unless these thermocouples are shielded from direct radiation received from other surfaces.

POST GRADUATE COURSES FOR VETERANS

The National Roster of Scientific and Specialized Personnel, U. S. Employment Service, Washington, D. C., has compiled a directory, intended primarily as an aid to veterans and war research workers, listing graduate courses offered and the assistance available to students in 188 colleges and universities.

[2]Radiation and Convection from Surfaces in Various Positions. G. B. Wilkes and C. M. F. Peterson. (ASHVE TRANSACTIONS. (Vol. 44, 1938, p. 513.)

[3]See Footnote 1.

Effect of Branch Take-Off Design on Noise in Ventilating Duct Systems

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JUST PRIOR to and during the war the ASHVE Research Laboratory carried on a number of research projects for the U. S. Navy, Bureau of Ships. The results of this work have recently been released for publication. This paper is an abstract of a longer report submitted to the Navy under the same title.

Test Set-up

The arrangement of the system used for this study is shown in Fig. 1. Drawings of the several sections of the system indicate the location of straighteners, orifice, and pitot tube stations. Air flow was controlled by terminal dampers at the ends of both the trunk and branch ducts, and a damper at the fan inlet. The center line of the duct was located at a height of 10 ft 0 in. above the floor and 3 ft 8 in. from the ceiling. An axial-flow type fan was used to move air through the system.

Sketches II and III of Fig. 1 show details of the two types of branch fittings studied. It should be noted that the sizes of branch and continuing trunk ducts are different for the two fittings.

Measurement and Analysis of Sound

Sound measurements were made with an Electrical Research Products, Inc., No. RA 245 sound level meter and four non-directional microphones. During the latter part of the study, a No. RA 243 analysis filter set was used in conjunction with the sound meter. With this filter, it was possible to study the noise level in any one of 14 frequency bands.

The microphones were connected to the sound meter and filter by shielded conductors of sufficient length that the meter and filter could be kept at a central observa-

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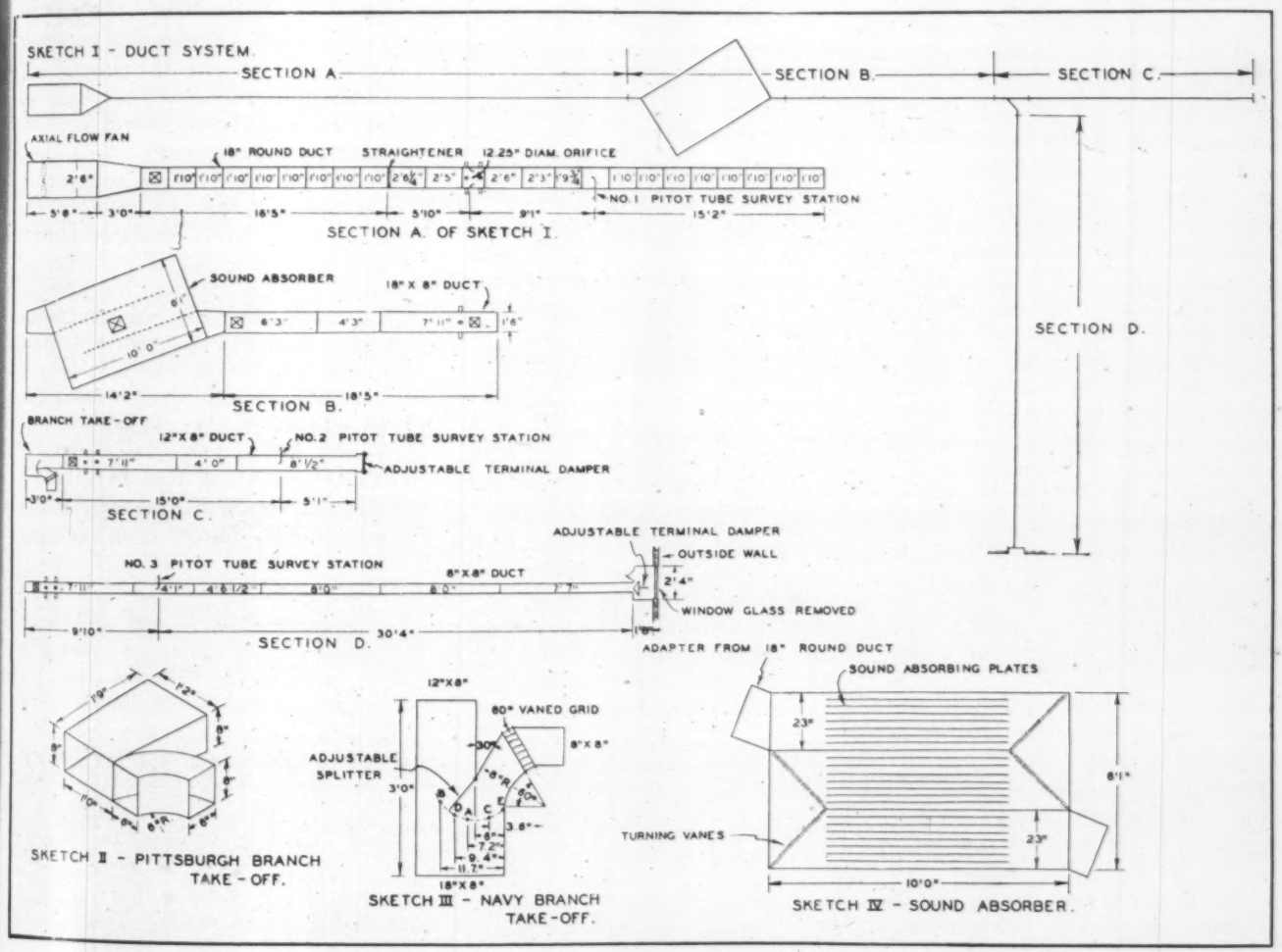


Fig. 1.—Layout of duct system.

tion station and the microphones moved to any desired point along the duct system. By using four microphones properly located in advance, it was possible to make comparative observations with little or no disturbance, and in a very short interval of time. Most of the actual testing was done at night after other noise making operations in the building were shut down, so that observations could be made with low and uniform ambient conditions.

Fig. 2 is a plan view of the room in which the study was made and shows the duct set-up and 18 numbered microphone stations. All of the sound levels herein reported were taken at stations 1, 2, 3, and 6. At stations 1, 2, and 3 the microphones were located on top of the duct and picked up the noise levels in the approach duct, continuing trunk duct, and branch duct, respectively. The microphone at station 6, located 5 ft above the floor and 5 ft below the duct, was used throughout the study to determine ambient noise levels.

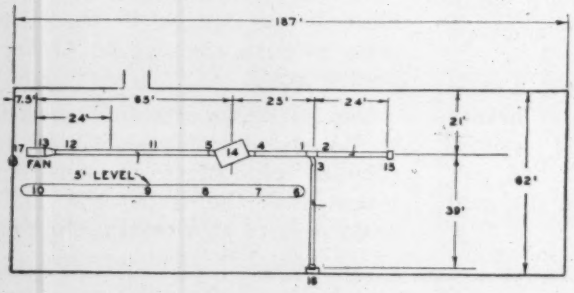


Fig. 2.—Plan view of test set in the laboratory showing location of observation stations

In the early tests it was difficult or impossible to separate the fan noise transmitted along the air stream from the noise created at the branch take-off. To reduce the fan noise level, a sound absorber, constructed as shown in Fig. 1, was installed between the fan and the branch take-off.

Noise Level in Branch Take-Offs

The first three series of tests were made with the Pittsburgh branch take-off. (See Sketch II, Fig. 1.) The next series, made with the Navy branch take-off with the splitter in the neutral position *A*, indicated somewhat higher noise levels than had been found with the Pittsburgh take-off. The order of difference is indicated in Table 1.

Table 1—Relative Noise Levels of Pittsburgh and Navy Take-offs[a]

Test No.	Branch Take-off	Velocity Feet per Minute			Noise Level in Decibels			
		Pos. 1	Pos. 2	Pos. 3	Pos. 1	Pos. 2	Pos. 3	Pos. 6
106	Pittsburgh	3890	3180	3640	88.5	87.5	91.5	79.0
126	Navy	3632	2990	3560	93.0	106.0	96.0	...

[a]Trunk and branch dampers open 4 in. and 8 in. respectively, and fan damper wide open during both tests.

In a fifth series of tests with the Navy take-off, the splitter damper was first set in the neutral position *A*, and the terminal dampers were adjusted to give the same velocities in the trunk and branch ducts. With the terminal dampers remaining in this position, the splitter damper setting was then varied and the resulting sound levels at the take-off observed. The results of some of these tests are given in Table 2. It is evident from these data that movement of the splitter damper in either direction from the neutral position resulted in an increase in noise level at at least one of the three microphone positions.

Methods of Reducing Noise in Branch Take-offs

A careful analysis of the data indicated that most of the noise observed with the Navy take-off was created back of the splitter in the continuing trunk duct, position 2, and that it was caused by turbulence in the bulk of relatively stationary air at that point. A number of tests were made with various modifications in the design of the splitter to determine methods of reducing this turbulence and the resulting noise. Some of the splitter designs tested and the results obtained are given in Table 3. From these results it is evident that the noise created at a splitter damper may be reduced appreciably by proper streamlining. However, this study was not carried to the point of developing an adjustable streamlined mechanism which would be capable of functioning as a splitter.

All of the tests recorded in Table 3 were made with the same terminal damper settings and at the same fan speed. The air delivery was, therefore, dependent only upon the frictional resistance of the system. It is interesting to note that, in general, as the noise level was reduced, the air delivery increased. In test No. 251, which indicated the lowest noise level, the air delivery was approximately 16 per cent greater than in test No. 236.

Effect of Microphone Arrangement on Noise Level

It was evident throughout the testing program that the actual numerical values of sound level obtained were dependent to a large extent on the location and general arrangement of the microphones. The sound levels observed during any particular series of tests can only be considered comparative, and since the microphone arrangement was changed several times during the study, not all series of tests are directly comparable. This is evident in a comparison of the results of test No. 126 given in Table 1 and test No. 162 given in Table 2. Much of the difference in sound levels observed in these two tests is due to a change in microphone arrangement.

A series of tests was made to determine more accurately the effect of microphone location and arrangement on total sound level and

Table 2—Variation in Sound Intensity Due to Variation in Splitter Setting[a]

Test No.	Splitter Positions[b]	Velocity Feet per Minute			Noise Level in Decibels			
		Pos. 1	Pos. 2	Pos. 3	Pos. 1	Pos. 2	Pos. 3	Pos. 6
162	A	4231	3654	3665	118.0	114.0	112.0	85.0
163	B	3635	2530	4120	117.0	128.0	118.0	87.0
164	C	3882	4225	2396	118.0	119.5	112.0	85.5
165	D	3998	3200	3812	118.5	121.0	115.0	85.0

[a]Trunk and branch dampers open 5⅝ in. and 8 in. respectively, and fan damper wide open during all tests.
[b]See Fig. 1, Sketch III.

Table 3.—**Noise Levels and Accompanying Velocities for Various Flow Regulating Devices in the Navy Branch Take-off**

Test No.	Splitter, Branch Take-off Arrangement		Velocity in Feet Per Minute			Noise Level in Decibels -- Total			
			Pos. 1	Pos. 2	Pos. 3	Pos. 1	Pos. 2	Pos. 3	Pos. 6
236	Splitter held in Position "B"		3453	2475	4030	101.1	126.1	105.7	66.7
238	Unbowed sheet at 10° to wall		3657	2565	3790	104.3	125.2	107.9	65.1
239	Convex-bowed sheet 32 3/4-in. attached to splitter "B" position		3817	2965	3470	98.9	113.8	105.6	63.2
240	Streamlined casing over "B" position of splitter		3762	3040	3580	97.2	108.3	102.2	68.2
241	5.7-in. dia. cylinder		3646	2905	3680	101.6	120.8	107.4	67.6
250	5.7-in. cylinder and 65-in. rigid tight fitting sheet, sealed with plastic cement		3788	3050	3660	97.8	117.5	103.0	66.2
251	Same as Test No. 250, except last 3 in. of rigid piece curved against cylinder		4006	3170	3360	97.5	99.3	103.2	65.8
252	Same as Test No. 251, except 1/4-in. ridge of Permoplast		3759	2875	3590	97.6	121.0	103.3	66.0

also on the sound levels in the several frequency bands. Readings were taken with different types of openings in the duct and with different housings over the microphones.

Fig. 3 is presented as an example of the method of analysis used in these tests. This figure shows the results obtained with an open 4 in. × 4 in. hole in the duct, no hole, the duct perforated with nine ¼ in. holes, and with 32 ¼ in. holes. In these four tests, the microphone rested on a ½ in. thick piece of sponge rubber laid on top of the duct, and was covered with a 5 in. × 12 in. × 8 in. deep box lined with ½ in. sound absorbing material.

In the graphic representation of frequency analysis, the total noise intensity within a band is shown by a horizontal line and the beginning and ends of these lines are connected by continuous curves. There are no overlapping bands in the frequency range below 50 and above 4800 cycles. The total noise levels, titled *Motor on, no filter, Motor off, no filter, Position 6*, etc., were taken at the beginning and end of each test, and are a check of constancy of noise conditions during the test; they do not refer to frequency variation but to the *duration of test* time scale. D_t, D_b and S refer to terminal trunk damper, terminal branch damper, and splitter setting, respectively.

The sound intensity distribution with respect to frequency as shown in Fig. 3 is typical of the results obtained throughout the study. In every test, the maximum intensity was found to be in or below the 75

U. S. NAVY REPORTS

The two papers (1), (2) published on pp. 101 and 107 of the March JOURNAL SECTION and the paper (4) beginning on p. 115 of this issue are condensations of reports made during the war to the Air Conditioning Section, Design Division, Bureau of Ships, U. S. Navy, by the Committee on Research.

A limited number of sets of three booklets containing the four complete reports, as reprinted for the Navy Department, are available and may be obtained from the ASHVE Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio, on application accompanied by a remittance of $3.00 to cover the cost of printing and postage. The booklets are available only in sets.

The titles of these complete reports are:

1. Physiological Response of Subjects Exposed to High Effective Temperatures and Elevated Mean Radiant Temperatures.

2. An Experimental Investigation of the Effect of Change in Atmospheric Conditions and Noise Upon Performance. (A Psychological and Physiological Study of the Accuracy, Variability and Volume of Work of Young Men in Hot Spaces with Different Noise Levels.)

3. Noise Measurement and the Physiological and Psychological Effects of Noise on Man.

4. Effect of Branch Take-Off Design on Noise in Ventilating Duct Systems.

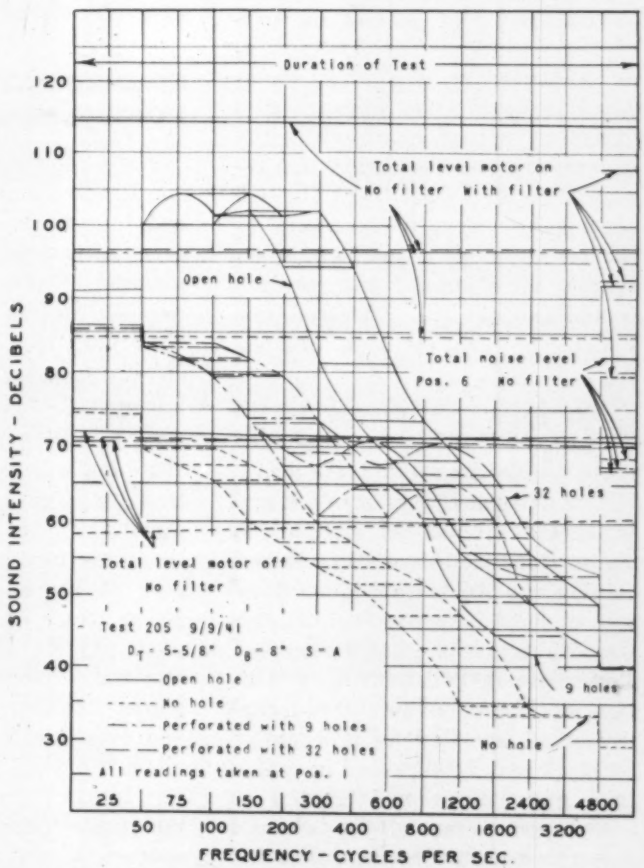


Fig. 3.—Noise level comparison for various openings in duct

to 150 cycles per second frequency band.

Summary

1. The noise created by the splitter in a branch take-off arises from the turbulence of a relatively stationary mass of air back of the splitter. The noise can be reduced by properly streamlining the splitter.

2. Noise level values obtained in a study of this kind vary widely depending upon the arrangement and location of the microphone, and the type of opening between the air stream and the microphone. Universally accepted standards of sound measurement techniques are badly needed in many phases of the ventilating and air conditioning industry. Until such standards are available, the proper interpretation of sound measurements, and the correlation of the results of various investigators in the field, will be difficult or impossible.

3. The greater part of the noise created in a duct system is of relatively low frequency. Maximum intensities in this study occurred at or below 150 cycles per second.

4. This study was confined to the performance of branch take-offs only, and does not provide a means of determining how much the noise level in a room may be increased due to a certain noise production in the duct system.

WEBB & MAHONEY FORM PARTNERSHIP

John S. Webb, a member of the ASHVE, and Francis W. Mahoney have associated for the practice of engineering under the firm name of Mahoney & Webb, with offices at 177 State Street, Boston, Mass.

MILENER, COORDINATOR OF GENERAL RESEARCH, *AGA*

E. D. Milener has been appointed coordinator of general research of the *American Gas Association*, as announced by H. C. Wolf, managing director. Mr. Milener's new duties consist of coordinating the general and technical utilization research of the association. He will continue to serve as secretary of the coordinating committee on research, the domestic gas research committee and the industrial and commercial gas research committee.

Mr. Milener, a member of the Society since 1936, was graduated from the Baltimore Polytechnic Institute and the University of Maryland, and studied engineering at Johns Hopkins University. Before joining the *AGA* staff in 1928, he was employed by the Consolidated Gas, Electric Light, and Power Co., Baltimore. In 1935 his responsibilities in connection with the organization of the extensive program of research and development in industrial gas utilization increased to include a program of fundamental research in domestic gas utilization under the direction of the committee on domestic gas research.

Other promotions in the *AGA* announced by Mr. Wolf included M. A. Combs, who was promoted from assistant secretary of the industrial and commercial gas section to secretary, succeeding Mr. Milener, and E. L. Hall will continue to direct the coordination of gas production research.

Edward Drew will join the *AGA* as assistant director of promotion and will assist in conducting industry wide promotional campaigns and in coordinating sales promotion activities of the association.

IES ANNOUNCES LIGHTING HANDBOOK

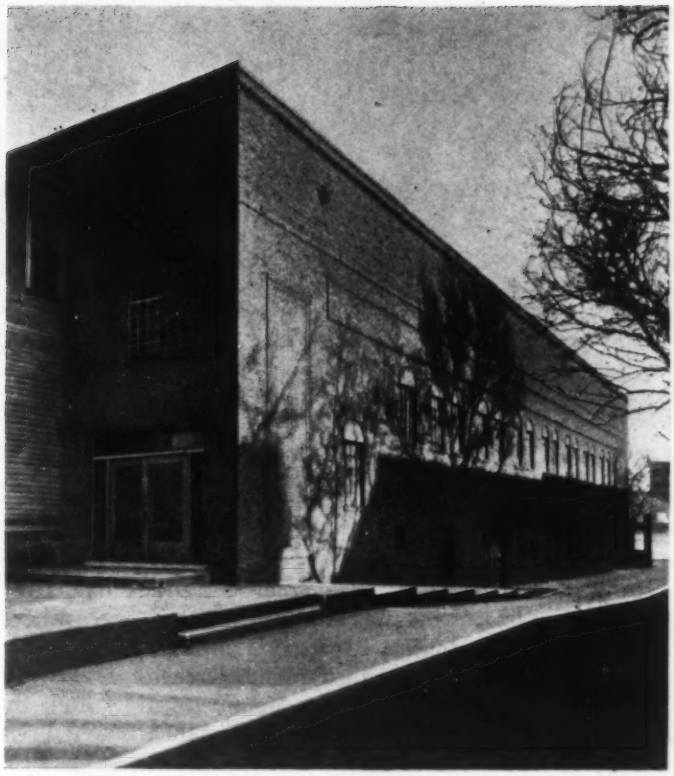
Plans for publication of a lighting handbook, most comprehensive and informative work of its kind ever attempted, have been announced by the *Illuminating Engineering Society*, 51 Madison Ave., New York 10, N. Y.

The handbook, long contemplated by the *IES* as a major postwar project, will appear in the fall of 1946 and will contain 500 pages of text prepared by outstanding authorities in their respective fields, according to C. A. Atherton, chairman of the handbook committee. Every phase of lighting, from the pure physics of light to specific lighting recommendations for stores, offices, homes, factories and even for juke boxes and television studios, will be covered in its 18 sections. The latest authoritative information on light sources, as well as on the measurement and control of light, will be included.

This reference guide will give architects, engineers, designers and others who plan, install, and manufacture lighting systems and equipment, all the basic knowledge on lighting which they need. In addition it will contain in greatly condensed, easily interpreted form, the latest information on good lighting practice and a manufacturer's reference section in which manufacturers can give technical data on their specific products.

The *IES* Lighting Handbook will be published in the convenient manual size of 6 x 9 in. and will be released in October 1946, with an initial printing of 7000 copies. It will be sold and distributed through official *IES* channels.

Members of the *IES* handbook committee are: C. A. Atherton, chairman, development engineer, Reynolds Metals Co.; A. A. Brainerd, Director, Lighting Service Division, Philadelphia Electric Co.; F. C. Eley, Illuminating Engineer, Toronto; J. M. Guillory, Manager, Industrial and Commercial Engineering Div., New Orleans Public Service Co.; C. C. Keller, Sales Manager, Holophane Co., Inc.; J. L. Kilpatrick, Manager Lighting Dept., Philadelphia Electrical & Mfg. Co.; H. L. Miller, President, Utilities Engineering Co.; J. W. Milford, Milford & Associates, Public Relations; R. G. Slauer, Manager, Applications Laboratory, Sylvania Electric Products; W. Sturrock, Manager, Engineering Publications, Nela Park Engineering Div., General Electric Co.; H. O. Warner, Director of Electrical Engineering, University of Detroit.



New Research Laboratory Building Purchased in Cleveland

PRES. A. J. Offner is pleased to announce that on April 1st the Research Laboratory of the Society started operations in its new home at 7218 Euclid Ave., Cleveland 3, Ohio, where adequate research facilities are available for serving the entire heating, ventilating and air conditioning industry as well as the associated industries. According to Mr. Offner, this represents another forward step in the Society's research program, which is in its 27th year and which is unique among national engineering societies.

The property consists of a substantial dwelling with a large two-story brick auditorium type building attached. Its location on one of Cleveland's main traffic arteries makes the Laboratory accessible from the center of the city and from east side railroad stations.

The brick building, which is 58 ft x 125 ft on its foundation, houses the Laboratory proper. At grade level are three large rooms with 11 ft ceilings and numerous small service rooms totaling about 5300 sq ft which provide excellent research, workshop and storage facilities. The only basement space is that provided for the heating plant.

The second floor of the Laboratory, which is of unusually heavy reinforced concrete construction, provides 4600 sq ft of floor space completely free of any obstruction with an 18 ft head room. Here will be located the psychrometric rooms to be used in studies on human comfort, radiant heating and radiant cooling. This space is also particularly well adapted for studies in air flow and air distribution.

To the rear of the Laboratory is a large unshaded area 85 ft wide and over 300 ft long where equipment for the study of solar radiation and associated problems will be erected.

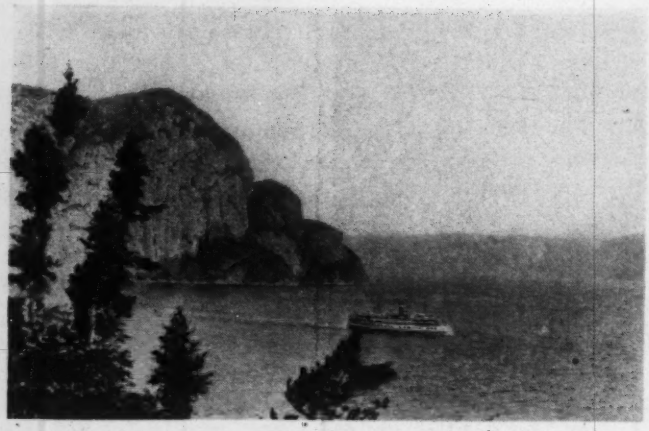
The three-story dwelling provides office space for the staff; Cyril Tasker, director of research, is in charge. He is assisted by C. M. Humphreys, senior engineer; H. B. Nottage; G. V. Parmelee; Dr. A. D. Brandt, assigned to the Society's Laboratory by the U. S. Public Health Service and a group composed of research assistants, technicians, and clerical aids.

All of the Society's research work is administered by the ASHVE Committee on Research, consisting of:

L. P. Saunders, *chairman*, Lockport, N. Y.; Capt. T. H. Urdahl, USNR, *vice-chairman*, Washington, D. C.; Dr. A. C. Fieldner, *Ex-officio*, Washington, D. C.; C. M. Ashley, Syracuse, N. Y.; Prof. F. E. Giesecke, New Braunfels, Tex.; F. C. McIntosh, Pittsburgh, Pa.; Prof. G. L. Tuve, Cleveland, Ohio.

R. M. Conner, Cleveland, Ohio; Dean John A. Goff, Philadelphia, Pa.; Prof. F. W. Hutchinson, Lafayette, Ind.; R. K. Thulman, Washington, D. C., and W. E. Zieber, York, Pa.

L. N. Hunter, Johnstown, Pa.; Prof. C. O. Mackey, Ithaca, N. Y.; R. D. Madison, Buffalo, N. Y.; Prof. L. G. Miller, E. Lansing, Mich.



Sailing on the Saguenay

Summer Meeting Cruise on the St. Lawrence

June 10, 11 and 12

A NOVEL LAND and sea meeting has been arranged for members of the Society June 10, 11, and 12, by the Montreal Chapter, which is to be host for the Semi-Annual Meeting 1946.

F. A. Hamlet, general chairman of the Committee on Arrangements, has advised Pres. A. J. Offner that the meeting will open at the Mount Royal Hotel, Montreal and will continue aboard the cruise ship *Quebec* down the St. Lawrence to Quebec, Murray Bay and Tadoussac.

It is planned to have three technical sessions and in advance of the sessions there will be a meeting of the Council, the Committee on Research and a number of meetings of Technical Advisory and other special committees.

Special reservation forms for the cruise will be mailed to members. Train and plane reservations should be made without delay and requests for hotel rooms, where overnight accommodations are desired, should be filed promptly. Announcement will be made shortly about special cars from both the eastern and western cities.

The tentative program provides for registration on Monday morning, June 10, at the Mount Royal Hotel, Montreal. A welcome luncheon at the hotel will be held at 12:15 p.m. and a technical session is scheduled for 2:00 p.m. with several papers on various phases of heating.

Ladies will enjoy a sightseeing and shopping tour during the afternoon and about 5:30 p.m. the members will board the *S. S. Quebec* for a cruise on the St. Lawrence River.

On Tuesday morning an air conditioning session will be held in the music room of the steamer and during the afternoon a golf tournament will be played on the Murray Bay course. For those who do not play golf there will be things to do and see at the Manoir Richelieu. During the boat trip there will be committee meetings and an opportunity for the Chapter Delegate and Nominating Committees to hold their sessions.

There will be a stop at Tadoussac on Tuesday evening which is the site of the oldest fur trading post and the oldest church in North America. The original trading post has been rebuilt in replica and contains a rare collection of Indian relics and other historical items recalling the early days of French Canada. Tadoussac is the gateway to the majestic Saguenay fjords. The Saguenay river is hemmed in by mountains and the visitor will see Capes Trinity and Eternity rising straight from the water's edge for over 2,000 ft.

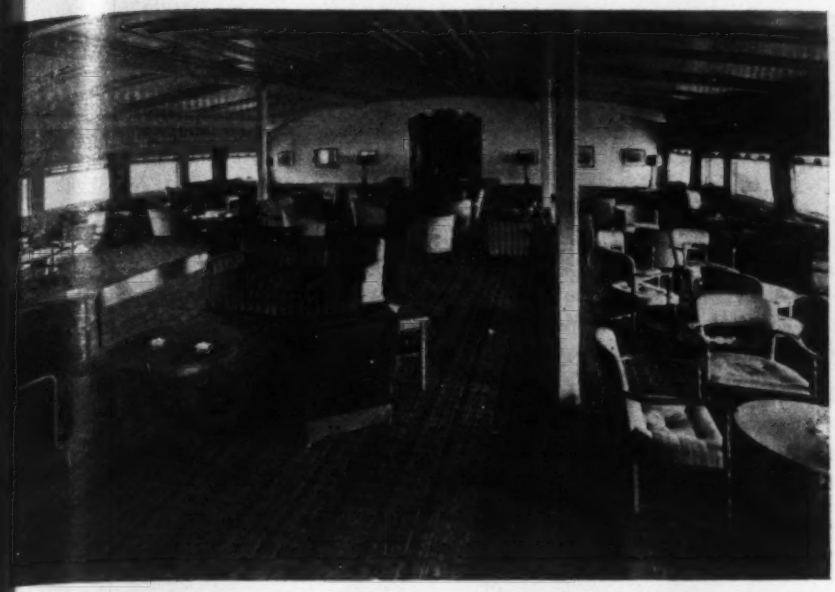
Wednesday morning there will be a research session in the music room of the steamer and in the afternoon there will be deck sports and games.

About 7:00 p.m. Wednesday evening the boat will dock at Quebec and the Semi-Annual Banquet will be held in the ballroom of the Hotel Frontenac.

The boat will sail from Quebec

View from Mt. Royal

Golf course at Manoir Richelieu



Music room on "A" deck where sessions will be held

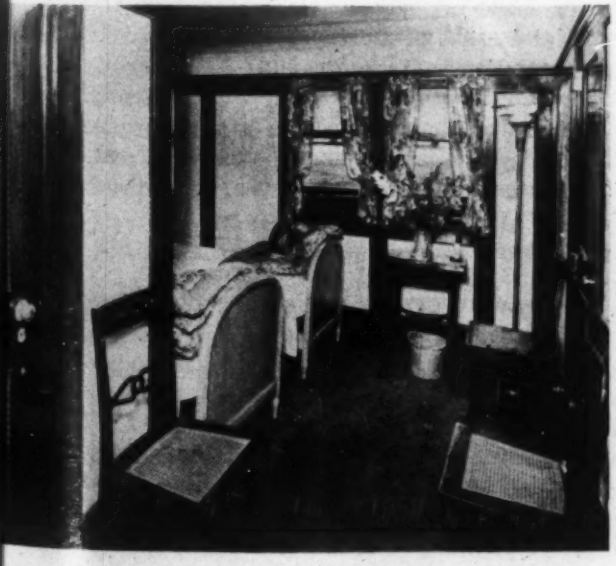
10:30 p.m., arriving in Montreal Thursday morning, June 13, at :30 a.m. This schedule will permit those who want to leave on morning trains to make connections and for those who drive there will be an opportunity for an early start. For those who leave on the night trains there will be a chance to do some additional sightseeing and shopping in Montreal.

The accommodations aboard the *S. S. Quebec* provide outside staterooms for 500 persons. There are a variety of types of comfortable staterooms with a limited number of accommodations with twin beds and private bath, double rooms with a double lower and single upper berths with private toilet and other staterooms with double lower and single upper berths. The cost for the roundtrip on the boat, including meals, per person U. S. funds including tax is as follows: $39.73 for ordinary cabins; $42.86 for staterooms with private toilet; and $52.27 for staterooms with private bath.

All reservations for the boat trip will be handled through the New York office of the steamship company and a special form will be furnished to all members by mail so they can file their requests for boat tickets, also golf and banquet reservations.

The local committee promises that everything possible will be done to make this trip to Canada an outstanding event for visiting members.

Deluxe stateroom S. S. Quebec



COMMITTEE ON ARRANGEMENTS

F. A. Hamlet, *General Chairman.*
Leo Garneau, *Vice-Chairman.*

Banquet—A. B. Madden, *chairman;* J. B. Flanagan, G. L. Ballantyne.

Entertainment — T. H. Worthington, *chairman;* A. F. Lamontagne, Jack Wright.

Finance—F. G. Phipps, *chairman;* J. D. Ross, Clifford A. Booth.

Inspection—A. M. Peart, *chairman;* J. G. Chenevert, W. J. Orr.

Ladies—J. J. Cosgrove, *chairman;* A. E. Watts, F. A. Sheppard.

Publicity—W. G. Hole, *chairman;* E. H. Terrence, J. H. Storey.

Sessions—J. B. Dykes, *chairman;* B. J. Horsburgh, Ralph Grossman.

Reception—W. W. Timmins, *chairman;* J. P. Fitzsimons, John Colford.

Secretary—S. W. Salter.

An Invitation to Members

The Meetings Committee wishes to encourage the authors who can and will prepare good technical papers for presentation to our Society. We are particularly interested in papers dealing with new or novel developments and which material can be incorporated into the literature and will assist others in the solution of current problems.

Any one of the committee members will be glad to consult by mail or otherwise with authors to predetermine whether the particular paper is desired and can be used. We need good papers on air conditioning of all kinds and new papers on air distribution, industrial hygiene and industrial ventilation.

Papers must be presented first to the Publication Committee for approval for publication and then are passed on to the Meetings Committee for selection to use at the Annual or Semi-Annual Meetings. We need papers planned now to take care of the Annual Meeting in January, 1947. If you have any papers you would like to suggest, please communicate with us.

THE MEETINGS COMMITTEE
Lester T. Avery, *Chairman*
F. W. Hutchinson
E. N. McDonnell

SUMMARY OF LOCAL CHAPTER MEETINGS*

ATLANTA—March 1, 1946. Subject: Latest Developments in Radiant Heating. Speaker: C. A. Hawk, Jr., Engineering Service Department, A. M. Byers Co., Pittsburgh, Pa. The talk was illustrated with slides and was followed by a spirited discussion. Attendance, 77. Attendance ratio, 0.37.

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CENTRAL OHIO—February 18, 1946. Subject: Electronics—The Magic of War and Peace. Speaker: Gordon Volkemont, Minneapolis-Honeywell Regulator Co. Minneapolis, Minn. Attendance, 82. Attendance ratio, 0.55.

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CENTRAL NEW YORK—March 12, 1946. This meeting was held jointly with the *National Warm Air Heating & Air Conditioning Association.* Subject: The Sol-air Thermometer. Speaker: L. T. Wright, Jr., assistant professor, Heat-Power Engineering, Cornell University, Ithaca, N. Y. After the talk a complete discussion was conducted by Prof. C. O. Mackey, also of Heat-Power Engineering at Cornell. Attendance, 55.

CENTRAL NEW YORK—February 20, 1946. A joint meeting was held with the *ASRE.* Subject: Engineering Fallacies. Speaker: Charles S. Leopold, consulting engineer, Philadelphia, Pa. Attendance, 119.

•

CINCINNATI—February 12, 1946. Subject: Electronic Air Cleaning. Speaker: J. W. May, Louisville, Ky. An interesting question and discussion period followed the talk. Attendance, 38. Attendance ratio, 0.46.

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DELTA—February 6, 1946. Subject: The Flake Ice Machine (a sound film) Speaker: Y. H. Feitel. Another sound film, The History of Higgins Boats, was shown for entertainment. James S. Adair, recently returned from the Armed Service, was welcomed by Pres. Walter Grant and the chapter members. Attendance, 20. Attendance ratio, 0.43.

•

GOLDEN GATE—February 20, 1946. Subject: Fans and Their Characteristics. Speaker: A. J. Boney, Sales Engineer, B. F. Sturtevant Co. After a very interesting and instructive talk, illustrated by charts, which were distributed among those present, the meeting was thrown open for discussion. Attendance, 48. Attendance ratio, 0.57.

ILLINOIS—February 11, 1946. Subject: Servicing of Mechanical Equipment. Speakers: W. A. Stuhl, General Maintenance Manager, Montgomery Ward & Co. L. E. Burke, General Maintenance Manager, Sears Roebuck & Co., George Bailey, Albert H. Wetten & Co. The talks were followed by a lively question and answer period. Attendance, 100. Attendance ratio, 0.57.

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INDIANA—March 1, 1946. Subject: Liquid Heat. Speaker: Orion O. Oaks; chief engineer, John B. Pierce Foundation, Raritan, N. J. The subject presented was very interesting. Attendance, 51. Attendance ratio 0.58.

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IOWA—March 12, 1946. Subject: Atomic Power. Speaker: Dr. A. F. Voight, Iowa State College, Ames, Ia. Dr. Voight was one of the men in charge of the Atomic Bomb Development Project at Iowa State College. He did a remarkably fine job of discussing development of atomic power in language that the audience could understand. Through the use of slides he outlined the development of atomic power and its application for providing power for use in the heating and ventilating industry. Dr. Voight was very generous in answering and discussing all the questions that were asked. Attendance, 24.

IOWA—February 12, 1946. Subject: Air Handling. Speakers: D. C. Murphy, D. C. Murphy Co.; Robert Schnell, Cons. Engr. associated with B. E. Landes with Tracy Johnson, Trane Co.; Perry LaRue, Supt. of Buildings and Grounds, Board of Education and C. P. North, Campbell Heating Co.; (all of Des Moines) co-operating; as the meeting was conducted as a forum. An interesting discussion period followed the talks. Attendance, 21.

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KANSAS CITY—March 5, 1946. Subject: Commercial Dehydration of Foods and Agricultural Products. Speaker: Martin Schuller, Midwest Research Institute. The entire Chapter stood in a silent tribute to Lewis Stephenson, a late member. Later in the evening movies on various subjects were shown. Attendance, 66.

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MASSACHUSETTS—February 19, 1946. Subject: Warm Air Panel Heating. Speaker: H. F. Randolph, International Heater Co., Utica, N.Y. Attendance, 54. Attendance ratio, 0.72.

MASSACHUSETTS—January 15, 1946. Subject: Refrigeration and Air Conditioning in the Rubber Industry. Speakers: L. G. Griebling, Engr. Dept., Firestone Tire & Rubber Co., Akron, Ohio, Walter Bartel, Ric-Wil Co.

*Note. The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

Cleveland, Ohio. Mr. Bartel showed pictures of the High Pressure Steam Line from the Power Plant to the Laboratory Building. Attendance, 40. Attendance ratio, 0.53.

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MEMPHIS—February 11, 1946. Subject: Water and Its Treatment. Speaker: Marion L. Crist. A round-table discussion followed the talk. Attendance, 18. Attendance ratio, 0.60.

•

MICHIGAN—March 11, 1946. Subject: Radiant Heating. Speaker: Harold Lockhart, Chief Engr. Bell and Gossett Co. As evidenced by the record attendance the subject was a popular one and Mr. Lockhart gave an intensely interesting talk. He purposely omitted any mention of technical data during the lecture, leaving it for the question and answer period. He was kept busy answering questions until after the usual adjournment time and only because he had to catch a train, saved him from an all-night session. Mr. Lockhart was accorded a hearty vote of thanks for his excellent address. Attendance, 297. Attendance ratio, 2.4.

•

MINNESOTA—February 13, 1946. Subject: Industrial Air Conditioning in War and Peace. Speaker: Lester T. Avery, President, Avery Engineering Co., Cleveland, Ohio. A discussion followed this most interesting talk in which Mr. Avery answered a number of questions. Pres. Gorgen introduced Chapter member Roger Mattson, in Military Service, who was home on furlough. Attendance, 77.

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MONTREAL—January 21, 1946. Subject: The Atomic Age. Speaker: Dr. Leo Yaffe, National Research Council. This was a most instructive talk and a spirited discussion and question and answer period followed. Attendance, 43. Attendance ratio, 0.40.

•

NEBRASKA—February 12, 1946. Subject: Heat and Its Control (a sound film). Speaker: Donald Fisher, District Manager, Johns-Manville Co. The picture was both educational and interesting. It was followed by a question and discussion period. Attendance, 18. Attendance ratio, 0.42.

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NEW YORK—February 18, 1946. Subject: Aviation and Automotive Heat Transfer Surface Development. Speaker: L. P. Saunders, Chief Engineer, Harrison Radiator Division, General Motors Corp. Mr. Saunders had a case of samples showing typical construction used in radiators and coolers. A vote of thanks was given the speaker for one of the most interesting talks given before the Chapter. The talk was followed by a question and answer period. Certificates of Life Membership were presented to Charles S. Hoffman, Charles E. Lucke and Clinton H. Quirk. Four newly elected members were presented to the Chapter: John K. M. Pryke, J. A. Shesler, Stuart Smith and Richard A. Wolff. Attendance, 64. Attendance ratio, 0.26.

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NORTH CAROLINA—February 22, 1946. Subject: Dehumidification Problems and Methods. Speaker: Capt. T. H. Urdahl, USNR, Washington, D. C. The talk was illustrated by slides and was followed by an open forum discussion, which proved very interesting to all present. Messrs. Buckley and Stephens, Canadian representatives of the Bahnson Co., were visitors at the meeting. Attendance, 40. Attendance ratio, 0.48.

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NORTH TEXAS—February 18, 1946. Subject: Should the Administration of the Army and Navy be Combined Under a Single Department? Speaker: Col. John B. Dunlap. This highly interesting talk was followed by a spirited discussion period. Messrs. W. H. Kuhn, R. E. Allison and H. J. Martyn were awarded Society pins for their perfect attendance record for 1945. Attendance, 46. Attendance ratio, 0.61.

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OKLAHOMA—February 18, 1946. Subject: A Single Equation Design Procedure for Radiant Panel Systems, paper by F. W. Hutchinson, presented at the Society's National Meeting. Speaker: E. T. P. Ellingson. An interesting question and answer period followed the discussion of the paper. Attendance, 26. Attendance ratio, 0.75.

•

ONTARIO—March 4, 1946. This meeting was especially dedicated as Victory Night—a tribute of the Ontario Chapter to Chapter members who served their country in World War II. Honored guests were: *Navy*—Sub. Lieut. R. P. Allsop, PO J. V. Bellman, Lieut. (E) H. G. Hill, Commander (E) J. M. S. Marriner. *Army*—Major L. P. Baker, Col. J. W. Bishop, OBE; Major E. A. Dowler, Lieut. Col. J. H. Fox, OBE; Major G. E. Smith, Lieut. W. J. Usher, Major M. B. Watson. *Air Force*—F/L E. L. Bowerman, F/O A. M. Dion, Squad. Leader C. E. Napier, Squad. Leader H. Treleaven, F/L A. W. Wood. A silent tribute was paid to P/O E. G. Armour, R. C. A. F., killed in action. R. H. Lock paid tribute to these members who helped make our victory possible. Addresses were made by Commander Marriner for the Navy, Colonel Bishop, OBE, for the Army and Squad. Leader C. E. Napier for the Air Force, Attendance, 88. Attendance ratio, 0.45.

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OREGON—February 7, 1946. Speaker: H. Bancroft Wells, Mgr., Tourist Convention Department, Portland Chamber of Commerce. Subject: Oregon Does Not Have Everything. Attendance, 44.

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PACIFIC NORTHWEST—February 12, 1946. Ray Le Riche reported on the national Annual meeting, giving a summary of the technical discussions and the

new method of appointing a nominating committee on a zone basis. A very pleasant surprise feature of the meeting was the presentation of a Life Membership in the Society to Prof. E. O. Eastwood. Attendance, 27.

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PHILADELPHIA—March 14, 1946. A resolution on the passing of Frederick D. Mensing, former treasurer of the Society and past president of the Philadelphia Chapter, was presented and voted to be sent to Mrs. Mensing. Subjects: Southwark Station (illustrated by slides) and Plan to bring Pocono Mountain Water to the City of Philadelphia. Speakers: James H. Harlow, assistant mechanical engineer, Philadelphia Electric Co., assisted by Mr. Richard Lane and R. L. Boyd, secretary, Lehigh Coal & Navigation Co. A great deal of interest was shown by the members at the discussion period after the talks. Attendance, 62.

PHILADELPHIA—February 15, 1946. Subject: Modern Marine Refrigeration and Air Conditioning, a paper by Dr. W. H. Carrier. Speakers: D. W. McLenegan, General Electric Co.; Llewellyn Williams, York Corp., and R. T. James, Robert Arnold Co. A very interesting discussion followed. Attendance, 90.

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PITTSBURGH—March 11, 1946. Subject: Making of Wrought Iron (a film). Speaker: C. A. Hawk, Jr., A. M. Byers Co. Attendance, 38.

PITTSBURGH—February 11, 1946. Subject: The Pittsburgh Park Plan, illustrated by slides. Speaker: Charles M. Stotz, Architect. An interesting question and answer period followed. Attendance, 29. Attendance ratio, 0.34.

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ST. LOUIS, MO.—February 5, 1946. Subject: Acoustics and Vibration Problems. Speaker: Prof. S. H. Van Wambeck, Electrical Engineering School, Washington University. A very interesting question and answer period followed Prof. Van Wambeck's excellent talk. Attendance, 41.

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SOUTH TEXAS—February 15, 1946. Subject: Chemical Dehumidifiers for Air Conditioning Installations. Speakers: D. A. Newton, F. J. Evans Engineering Company, Atlanta, Ga., and Mr. Fred Johnson, Surface Combustion, Kathabar Department. Attendance, 58.

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SOUTHERN CALIFORNIA—February 13, 1946. Subject: Anti-submarine Warfare and Atomic Power. Speaker: Dr. Vern O. Knudsen, Professor of Physics and Dean of Graduate Study, Los Angeles Branch, University of California. This was a very interesting talk and greatly appreciated by the chapter members. Attendance, 68.

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UTAH—March 6, 1946. President H. G. Richardson made an interesting report as to the activities and organization of the Utah Chapter. Ty Young, the new President of the Utah Chapter, gave a report of the activities at the National Meeting. Attendance 23. Attendance ratio, 0.70.

UTAH—February 6, 1946. Subject: Activities of the Research Department, University of Utah, as Related to Industry. Speakers: Dr. J. Hugh Hamilton and his assistant, Phil Elsey. The enthusiastic applause was evidence of the manner in which Dr. Hamilton's address and remarks by Mr. Elsey were received by those present. Attendance, 18. Attendance ratio, 0.42.

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WASHINGTON, D. C.—February 6, 1946. A. J. Offner, National President of ASHVE, and Charles S. Leopold, National President of *ASRE*, were guests. Subject: The Technical Man in the Post War World. Speaker: Dr. Harvey N. Davis, President of Stevens Institute of Technology. He added humor to an interesting consideration of technological advances by simply stating that post war technical men would still be technical, but more so. Another feature of the program was George C. Hench, self-styled pitchman and magician, who performed for a record audience. Attendance, 209.

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WESTERN MICHIGAN—February 11, 1946. A brief but comprehensive report of the Annual Meeting held in New York was given by S. H. Downs, past National President, Ken. Robinson, H. D. Bratt, C. A. Pesterfield and Tom Stafford. Attendance, 46. Attendance ratio, 0.74.

WESTERN MICHIGAN—January 14, 1946. This meeting was especially designated as Ladies Night. An excellent program was arranged by O. D. Marshall and his committee. There were readings, a quiz contest on identities with biographical incidents as clues, soprano solos by Mrs. Dave Metzger, community singing and the showing of a film on Check Forgeries. One feature of the evening was the awarding of nylon hose to four women. Another feature was that some of the members were given an opportunity to demonstrate their capabilities as buyers and salesmen. Items sold were given to the purchaser and the revenue went into the general fund for expenses. Messrs. F. Ward Brundage, Joe Brundage, Wellington (Bill) Bradfield and Emory Williams, recently discharged from the Service, were welcomed by the chapter members. Attendance, 74. Attendance ratio, 1.27.

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WESTERN NEW YORK—February 11, 1946. A brief report of the National Annual Meeting was given by Herman Seelbach. Subject: Atomic Energy. Speaker: Dr. Alexander Schwarcman, Research Director, Spencer Kellog Co. The first half of the talk was concerned with the major developments in chemistry in the last 100 years and the remainder of the talk outlined the development of the atomic bomb up to date. The entertainment committee was congratulated on their selection of the speaker for the meeting who gave such an interesting talk. Attendance, 32.

AKERMAN APPOINTED TO FACULTY OF MILWAUKEE SCHOOL OF ENGINEERING

Pres. Oscar Werwath, Milwaukee School of Engineering, announces the appointment of J. R. Akerman as head of the department of heating and air conditioning.

Mr. Akerman, a member of the ASHVE, is a native of Wilmington,

J. R. Akerman

N. C. He received his B.S. degree in mechanical engineering at the Georgia School of Technology and his M.S. degree from the Graduate School of the University of Michigan, Ann Arbor, Mich. He was employed with the Phoenix Oil Co., Augusta, Ga., and the U. S. Rubber Co. plant, Eau Claire, Wis.

This appointment, according to President Wermath's announcement, brings to the staff a man widely versed in the field of domestic and commercial heating and ventilation. It is Mr. Akerman's objective in returning to the teaching field to develop outstanding heating and air conditioning service and technician courses.

GOVERNMENT AND RESEARCH

Shall the federal government acquire all patents based on research by private industry in which federal funds were used and make use of patents so acquired as may be deemed best, was the subject of a talk delivered by Bruce K. Brown, vice-president in charge of development of Standard Oil Co. of Indiana, before a meeting held jointly by the *Engineers' Society of Milwaukee* and the Wisconsin chapter of the ASHVE, at the Pfister Hotel, Milwaukee, February 20.

Mr. Brown discussed the control of research results developed during the war under government sponsorship and the need for maintaining competition in the field of research. One proposal by Dr. Bush, regarding the shortage of scientific personnel, was that the training of men and performance of basic research in colleges and universities could be supported by federal funds. It was indicated that the greatest single support that the federal government could give to science would be to help train its workers by supplying funds for scholarships and fellowships. Technical information required during the war could be widely disseminated. A nonpartisan and nonpolitical board of scientific men could be established to disburse funds for these purposes, this institution to be known as the National Research Foundation. Patents could play only a minor

B. K. Brown

part, since basic research and the training of scientific personnel are the points to be stressed. So far as patents may be involved, the National Research Foundation should be left free to administer the problem in its best judgment.

The speaker thought that the Fulbright bill should have the careful scrutiny of all engineering organizations.

NEW POST IN STOKER ASSOCIATION

Announcement has been made by Marc G. Bluth, Executive Secretary of the *Stoker Manufacturers' Association*, of the appointment of Lloyd L. Connell, Richmond, Va., to the newly created post of Technical Director of the Association. Mr. Connell will handle and supervise the technical and engineering projects and problems of the Association, involving the stoker industry as a whole, working under the direction of the Association's Engineering and Research Committee.

SHERBROOKE HEADS NEW CO.

Piping Specialties, Inc., was formed March 1, 1946, to supply the same products and engineering service with the same manufacturing facilities provided by Pipe Specialty Engineering Co.

Walter A. Sherbrooke, Vice President of New York Chapter of the Society, is President; with C. A. Baker, until recently Vice President of Baker Ice Machine Co., Vice President; Mark J. Nicolich, formerly with Gibbs & Cox, Inc., Treasurer; and L. O. Acker, formerly with the *Association of Ice Cream Manufacturers* and the National Power & Light Co., subsidiary of Ebasco Services, Secretary.

Mr. Sherbrooke, a graduate of M.I.T., is a professional engineer in New York. He has held many assignments during the past 20 years in the Heating and Power Piping Div., Grinnell Co., and is a member of the Technology Club of New York.

ILG ANNOUNCES NEW DISTRICT MANAGER

B. G. Silberstein, manager of the Cincinnati branch office of Ilg Electric Ventilating Co. since 1929, has been appointed Ohio Valley district

B. G. Silberstein

manager, according to an announcement by P. D. Briggs, vice-president and general sales manager. In this capacity he will supervise engineering and sales activities of Ilg branch offices in Cincinnati, Columbus, Louisville, Knoxville, Charleston, and West Virginia.

Mr. Silberstein received his degree in electrical engineering from the University of Michigan. He has been a member of the Society for the past nine years and has participated in the activities of the Cincinnati chapter.

CHAPTER DELEGATES MEET AND ELECT LESER

A MEETING of Chapter Delegates convened in Parlor A, Hotel Commodore, New York, at 9:45 a.m., January 28, 1946, with H. E. Sproull presiding.

Chairman Sproull gave a few words of greeting and noted that there were a lot of new faces in the group. He hoped that this would be a good meeting and now that the war was over, our minds could be on other things besides the production of fighting material.

The roll indicated that 35 of the 37 chapters were represented.

The first item of business was the approval of the minutes of the Boston meeting.

Chairman Sproull called for the Agenda report and in the absence of W. C. Bevington, chairman, I. W. Cotton of the Indiana Chapter presented the report.

After discussing the method of determining the percentage of attendance at some length and whether it was based on the total attendance at a given chapter meeting including guests, or on the percentage of actual members present at a given meeting, on motion of Mr. Lowe, seconded by Mr. Seelbach, it was

VOTED: That all chapters in reporting their percentage of attendance should base it on the total number of members present, excluding the guests, as against total chapter membership.

On the subject of ways and means to increase chapter membership and keep the membership alive, Chairman Sproull said that this was a very live subject and he had asked Mr. Winans, chairman of the Chapter Relations Committee, to comment.

On motion of Mr. Leser, *seconded by* Mr. Locke, it was voted that chapter delegates express appreciation of the chapter members to Mr. Winans for his efforts in assisting the chapters through his news letters.

Mr. Winans felt it was rather presumptuous for him to discuss this matter of furnishing speakers to chapters because the Chapter Delegates Committee chairman had done a very marvelous job in the past few years. In fact, he believed, the chairman had written the Chapter Relations Committee rules which were adopted by the Council in 1944 and they were the guide by which speakers can be obtained for the chapters. He said that since September 1st, 20 speakers had been furnished to 16 chapters, not including the officers; that the scheduling of speakers or officers to chapters was done by the secretary of the Society under the auspices of the Chapter Relations Committee.

In addition to furnishing the speakers, the Chapter Relations Committee had been putting out news letters. He did not know whether the incoming Chapter Relations Committee would do that or not. The budget for the year ending October 31 included an item of expenditure for the Chapter Relations Committee of $1,254. It had been noted that the chapters had been somewhat negligent in returning the questionnaires after the speaker had talked.

Chairman Sproull presented Dr. B. M. Woods, who spoke on Society Finances and Payment of Expenses of Delegates.

In his remarks Dr. Woods said that if the members would review the financial figures, they would recognize that the Society had a unique position in the support that it gives to research.

He pointed out that the Council had authorized drafting amendments to the Constitution that would permit moving funds out of the Endowment Fund for purposes voted by the entire membership. Those amendments, he said, would come up for consideration at the Annual Meeting and would have to be passed substantially as they were to carry out the operations of the Research Laboratory.

Prof. G. L. Tuve was introduced by the chairman. His subject was Extending the Scope of the Research Program.

He stated that the chief thing he had to report was that the research program had made very substantial progress in the last year particularly in organization and in resuming what might be called reconversion.

He further reported that the tie with the U. S. Public Health Service was an important one as industrial ventilation was now being examined very carefully by the U. S. Public Health Service.

Professor Tuve said that they were ready to go on a new program setup on the basis of $110,000 a year budget for a three-year program and he urged that members of the Society be sure to let the committee know what their problems are and see that their local men get on the technical advisory committees, as they are the original planning group.

Chairman Sproull then called on E. N. McDonnell, Chicago, who spoke on Future Society Meetings and the new housing plans for the Research Laboratory.

He stated that the question of meetings has been a tough one in the past few years because of transportation and crowded hotel accommodations, and the meetings had not been sectionalized as they would like to have had them, but they would like to take the meetings to various sections of the country as they were scheduled before the war. He expressed the hope that chapters would send invitations.

He pointed out that according to the Constitution the Annual Meeting should be held on the fourth Monday in January. The committee hoped that would be changed so that the Council would have some leeway in setting Annual Meeting dates in case the dates should conflict with other meetings being held in a city at the same time.

Mr. McDonnell said regarding the housing of the Research Laboratory that 26 individual properties had been investigated to find suitable quarters. As our lease expires in March of this year on the present building, plans had been drawn for a laboratory and the quotation received had been a little over $80,000. Recently a fine property had been found at 7218 Euclid Ave., Cleveland, and an option was held on it.

The Committee on Research, Mr.

McDonnell said, was very much in favor of the building and the Finance Committee had approved the arrangement. The Society could move into the new Laboratory about March 15 and the research program would not be seriously interrupted.

Mr. McDonnell further stated that another committee on fund raising for research purposes, headed by Pres. A. C. Willard, University of Illinois, had been initiated.

At the suggestion of Chairman Sproull and *on motion* of Mr. Leser, *seconded* by Mr. Klages, it was voted that the present Agenda Committee be discharged.

The chairman then suggested that a new Agenda Committee be set up for the summer meeting.

Mr. Klages *moved* that the present chairman be asked to appoint one member from each region so that all matters could be handled within a short time by the Agenda Committee. Mr. Kroeker *seconded* the motion; it was voted and carried.

Mr. Sutfin *moved* that the group select one of its members as chairman to fill out the remaining six months until June, that he handle the June meeting and that at that time a man be elected to go on from the period set up in the By-Laws. Mr. Sherbrooke *seconded* the motion; it was voted and carried.

Fred Leser was elected Chairman of the Chapter Delegates Committee.

Mr. Kroeker *moved* a suggestion to the Council that for future meetings that at least two meeting periods for the Chapter Delegates Committee be provided. The motion was *seconded* by Mr. Lowe; it was voted and carried.

Mr. Klages *moved* that the delegates thank the present chairman for his patience, his fairness and sincerity in conducting the meetings, acknowledging the fact that he had been limited in every possible way. Mr. Locke *seconded* the motion; it was voted and carried by a rising vote.

Chairman Sproull responded that he had enjoyed trying to serve the delegates and thought all had a pretty good time and had become a little better acquainted, which, after all, was important in being here; that the esprit-de-corps in the Society seemed to be on the upgrade and that he was looking forward to seeing them all again at the next meeting. He then asked Mr. Leser to come forward and presented him as the new chairman.

Mr. Locke *moved* that the meeting be adjourned until June. Mr. Donceel *seconded* the motion; it was voted and carried, and the meeting thereupon adjourned at 12:30 o'clock p. m.

NEW TESTING LABORATORY OPENS IN WEST

Pres. H. C. Troth, Auto Coolers, Inc., Cleveland, Ohio, announces the opening of a laboratory for the developing and testing of its products at 1075 Third Street, Palo Alto, Calif. Lawrence W. Washington, a member of ASHVE, has been appointed Vice-President and Director of the Laboratory.

McFARLAN OPENS NEW OFFICE

A. I. McFarlan Company, Inc., contractors, air conditioning, heating and refrigeration, have opened offices at 21 West Street, New York, N. Y. Mr. McFarlan is a member of the ASHVE.

CLYDE R. PLACE DIES IN NEW YORK

Clyde R. Place, outstanding consulting engineer, died in New York City, March 28th at the age of 68. He was born at Mt. Upton, N. Y., September 18, 1877, and was graduated from the Massachusetts Institute of Technology. Mr. Place began his career as an apprentice with the Brooks Locomotive Works, where he did simple locomotive construction designing. He then became liability inspector of factories, elevators and construction work for Travelers Insurance Co., Hartford, Conn., and later for the same company in Greater New York. He was widely known as a specialist in engineering design, having planned the mechanical, electrical, elevator, air conditioning and power plant systems for many public buildings, among them Rockefeller Center; Grand Central Terminal; the Subway Terminal in Los Angeles; the Peking University, Peking, China; the National Gallery of Art in Washington, D. C.; the Elgin Gallery of the British Museum, London; and the Thomas Jefferson Memorial, also in Washington.

In 1930 Mr. Place was the recipient of the National Award of the Silver Beaver for distinguished volunteer service as chief consulting engineer of the Ten Mile River Boy Scout Camps at Tusten, N. Y. He was cited by former Mayor Fiorella H. La Guardia for exceptional public service to New York City for his work as consulting engineer on the housing and building programs. During World War II his engineering organization was engaged almost exclusively in the construction of camps, training centers, and port facilities.

Mr. Place served on many committees dealing with the codification of regulations and standards governing heating, ventilation, plumbing, power and elevator service. He became a member of the ASHVE in 1924, affiliated with the New York Chapter and participated in many Society activities. He was a former president of the First Avenue Association and served as director of the Boy Scout Foundation of Greater New York, the New York Building Congress and other groups.

The Council and Officers of the Society extend their deepest sympathy to his widow, Mrs. Mabelle Boyd Place, 333 E. 57th Street, New York City; his daughters, Mrs. H. Ware Knudson and Mrs. Richard Allan Mason, both of New Canaan, Conn.; and a son, John Foster Place of Williams College, Williamstown, Mass.

Funeral service was held at Christ Church Methodist, Park Ave., New York.

ALFRED L. BROWNE DIES

It is with deep regret that the Society learns of the passing of Alfred L. Browne, after a short illness, on February 8th.

Mr. Browne was born at Cornwall-on-Hudson, New York, January 1, 1889, and received his education in New York schools. He was employed with the Fischer-Sweeny Bronze Co., New Jersey, and then with the Illinois Engineering Company as their New Jersey representative and later as their Eastern representative. He held the latter position for over twenty-five years. He was the inventor and patentee of a vapor heating apparatus and has to his credit the supervision of many important jobs in heating and ventilating installations. He was a member of the Society for 23 years, and was active in the New York Chapter.

The Officers and Council of the Society extend their sincere and heartfelt sympathy to his widow, Mrs. Marguerite P. Browne, and to his sister, Mrs. Betty Coleman, Ft. Lauderdale, Fla.

DEATH OF OTIS E. DAVIS

Otis E. Davis, Scottsbluff, Neb., passed away after a lingering illness, March 6, 1946, according to word just received. Death was due to a heart ailment.

Mr. Davis was born in Edgar County, Ill., September 8, 1879. He received his education in Illinois and graduated from York College. He was in the heating and plumbing business at Auburn, Neb., for eight years and then served as major in the infantry, U.S.A., during World War I. After returning from the service he was employed as estimator and salesman by the Cornell Supply Co., Lincoln, Neb.; then became heating engineer with the Dempster Mill Mfg. Co., Beatrice, Neb., and in 1926 he became a sales engineer with Hoffman Specialty Co., Waterbury, Conn., where he was employed until he retired at the close of the year, 1945. He was with the latter company for nearly 20 years, designing, inspecting and promoting sales of steam vapor-vacuum heating.

A member of the ASHVE since 1929, Mr. Davis was affiliated with the Nebraska Chapter and participated in Society activities.

The Council and Officers of the Society extend their deepest sympathy to his widow, Mrs. O. E. Davis, Box 98, Scottsbluff, Neb., in her bereavement.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the Journal of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 94 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by May 15, 1946, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

AKERMAN, JOSEPH R., Milwaukee School of Engineering. PROPOSERS: H. W. Schreiber, J. R. Vernon. SECONDERS: M. M. Herrick, H. W. Alyea. *(Advancement)*

ANDERSON, EDWARD R., Appl. Engr., B. F. Sturtevant Co., Div. of Westinghouse Electric Corp. PROPOSERS: C. R. Ammerman, G. O. Jackson. SECONDERS: C. F. A. Locke, G. B. Supple.

BAGHI, A. R. M., Service Engr., Anglo-Iranian Oil Co., Ltd., PROPOSERS: A. Smillie,* W. S. Lawson*, SECONDERS: G. B. Gibbons,* W. N. Gemmill.*

BARKLEY, KENNETH L., Designing Draftsman, Ecusta Paper Corp. PROPOSERS: R. E. Mason, Karl Selden, Jr. SECONDERS: E. S. deWitt, W. M. Wallace, II.

BERGMAN, HAROLD, Sales Repr., J. A. Zurn Manufacturing Co. PROPOSERS: E. E. Maurer, G. C. Stobbe. SECONDERS: A. M. Fenwick, J. L. Frisse.

BLANKENSHIP, DICK, Engr's. Asst., W. Bruce Morrison. PROPOSERS: W. B. Morrison, J. J. Byrne. SECONDERS: A. E. Finlay, A. C. Clark.

BOEHM, ROBERT C., Appl. Engr., Fulton Sylphon Co. PROPOSERS: N. W. Barnes,* F. A. Doody.* SECONDERS: E. T. Cato,* T. N. Schroth.*

BRAZ, ALFRED, Archt. Engr., PWD Naval Air Station. PROPOSERS: W. H. Webster, Jr., R. C. Thomas, SECONDERS: W. W. Powers,* V. W. Watson.*

BRYAN, W. L., Jr., Research Engr., York Corp. PROPOSERS: W. E. Zieber, Leonard Greenberg. SECONDERS: S. F. Nicoll, R. L. Bennett.* *(Advancement)*

BUTLER, DAVID H., Sales Mgr., Iron Fireman Manufacturing Co. PROPOSERS: William Philip, H. S. Moore. SECONDERS: W. R. Blackhall, M. W. Shears.

CARLSON, E. EUGENE, Engr., B. F. Sturtevant Co. PROPOSERS: A. C. Bartlett, W. P. Buchanan. SECONDERS: F. C. Dawson, W. A. Minkler.

CARTER, A. B., Partner & Mgr., Farwell Co., PROPOSERS: J. P. Ashcraft, B. S. Foss, Jr. SECONDERS: J. A. Ray, E. J. Stern.

COCHRANE, RICHARD L., Engr., The James Robertson Co. Ltd. PROPOSERS: J. J. Lawlor, M. W. Shears. SECONDERS: J. F. Fox, William Philip.

COLBURN, GERALD W., Mgr., Minneapolis-Honeywell Regulator Co. PROPOSERS: K. R. Maganell, M. J. Olson. SECONDERS: D. D. Williams, C. A. Carter.

COLLINS, JOHN W., Chief Engr., National Heating Products Ltd. PROPOSERS: L. A. Hood, J. R. Dupuis. SECONDERS: W. W. Timmins, J. J. Cosgrove.

COX, WILLIAM A., Jr., Pres., Cox-Frank Corp. PROPOSERS: J. A. Johnston, C. F. Wood, SECONDERS: Herman Worsham, C. D. Graham.

DAVIS, LESTER T., Project Mgr., Standard Engineering Co., Inc. PROPOSERS: H. H. Hill, K. D. Boucher. SECONDERS: W. E. Kingswell, W. C. Jones.

*Non-member.

DE VINES, HOLLIS L., Air Cond. Engr., R. F. Taylor, PROPOSERS: R. F. Taylor, C. C. Quinn. SECONDERS: A. D. Sheere, A. F. Barnes.

DONIE, ROWLAND A., Sales Engr., Minneapolis-Honeywell Regulator Co. PROPOSERS: C. F. A. Locke, J. S. Locke. SECONDERS: I. W. Cotton, G. B. Supple.

DONOHUE, ORVILLE P., Engr., Allis Chalmers Manufacturing Co. PROPOSERS: C. H. Amundson, E. W. Gifford. SECONDERS: G. M. Hinkamp,* L. F. McCaffrey.*

DOODY, FRANK A., Appl. Engr. Fulton Sylphon Co. PROPOSERS: N. W. Barnes,* M. L. Buckley.* SECONDERS: E. T. Cato,* R. C. Boehm.*

DOUDICAN, CHARLES T., Htg. Engr., M. J. Gibbons Supply Co. PROPOSERS: M. J. Gibbons, H. A. Pillen. SECONDERS: E. J. Richard, K. B. Little.

DUGAN, JACK A., Sales Engr., Minneapolis-Honeywell Regulator Co. PROPOSERS: R. E. Le Riche, D. C. Griffin. SECONDERS: C. W. Finn, E. L. Weber.

EBNER, ROBERT C., Mech. Designer, Frederic E. Sutton. PROPOSERS: H. H. Bond, Joe Wheeler, Jr. SECONDERS: C. S. Pabst, C. S. Koehler.

ECK, MELVIN C., Sales Engr., Bryant Heater Co. PROPOSERS: H. W. Heisterkamp, K. T. Davis. SECONDERS: L. C. Harvey, J. L. Frisse.

EMERSON, EDWARD K., Engr., Swift & Co. PROPOSERS: J. F. Tobin, H. T. Kucera. SECONDERS: M. J. Bamond, C. H. Bevington.

ERVIN, FRED R., Instructor, Mech. Engrg., Duke University. PROPOSERS: F. J. Reed, E. S. Theiss. SECONDERS: W. A. Hinton,* R. S. Wilbur.*

FAILOR, CREST A., Sales Engr., Baker Manufacturing Co. PROPOSERS: J. C. Engskow, B. G. Peterson. SECONDERS: J. G. Bierl, Henry Kleinkauf.

FAKTER, MELVIN, Engr., The Austin Co. PROPOSERS: C. E. Crone, J. J. Philippi. SECONDERS: J. S. Locke, C. M. Burnam, Jr.

FARMER, JERRY E., Pres., The Saxet Co., Inc. PROPOSERS: W. A. Catlett, J. P. Ashcraft, SECONDERS: C. C. Young, Oslin Nation.

FELZER, WILLIAM, Naval Archt., U. S. Navy Department. PROPOSERS: J. M. Huff, R. J. Lee. SECONDERS: F. W. Kolb, N. H. Peterson.

GOULD, MARVIN E., Asst. Prof., Iowa State College. PROPOSERS: R. K. Smith, E. O. Olson. SECONDERS: B. E. Landes, R. S. Stover.

GOWAN, GILBERT J., Engr., East Ohio Gas Co. PROPOSERS: G. V. Parmelee, C. A. McKeeman. SECONDERS: C. F. Eveleth, E. J. Sable.

GRAY, RICHARD O., Htg. Engr., H. F. Brown. PROPOSERS: W. H. Webster, Jr., R. C. Thomas. SECONDERS: W. J. Gorsuch, F. G. Hurst.

HAINES, FRANK H., Vice-Pres., Standard Engineering Co., Inc. PROPOSERS: H. H. Hill, W. E. Kingswell. SECONDERS: K. D. Boucher, W. C. Jones.

HAINES, ROGER W., Engr., The King Co. PROPOSERS: G. A. M. Anderson, F. B. Rowley. SECONDERS: A. B. Algren, R. C. Jordan.

HANSON, FRANK E., Gas Engr., Servel, Inc. PROPOSERS: C. H. Flink, N. E. Berry. SECONDERS: C. T. Boyer, H. C. Pierce.

HARTMAN, P. C., Jr., Owner, P. C. Hartman Co. PROPOSERS: W. H. Webster, Jr., R. C. Thomas. SECONDERS: F. G. Hurst,* G. J. Hoyer.*

HAYES, WILLIAM C., Sec'y-Treas., Hayes Distributing Co. PROPOSERS: R. C. Thomas, W. H. Webster, Jr. SECONDERS: F. G. Hurst,* P. C. Hartman, Jr.*

HENRIKSEN, HARVEY E., Indus. Project Engr., General Controls Co. PROPOSERS: J. I. Sprott, K. O. Alexander. SECONDERS: N. H. Peterson, H. V. Hickman.

HESS, NEWTON T., Market Mgr., Vorys Brothers, Inc. PROPOSERS: A. T. English, Louis Favret. SECONDERS: McGee Swepston, Arthur Bogen.

HIRATSUKA, SHIGEKI, Designer & Draftsman, Meyer, Strong & Jones, Inc. PROPOSERS: A. Bassevitch, D. J. Whealton. SECONDERS: Francis Ficarra, T. J. Cox.*

HORN, EDWARD C., Engr., J. M. Gallagher Co. PROPOSERS: Foskett Brown, W. C. Armistead. SECONDERS: V. M. Lathers, W. W. Kennedy.

HURST, FLOYD G., Design Engr., P. C. Hartman Co. PROPOSERS: W. H. Webster, Jr., R. C. Thomas. SECONDERS: P. C. Hartman, Jr.,* G. J. Hoyer.*

JESSUP, BENJAMIN A., Plbg., Htg. & Sheet Metal Contr. PROPOSERS: E. R. Clement, Sr., L. O. R. Clark. SECONDERS: E. J. Ritchie, R. W. Cumming.

JOUANNO, E. P., Gen. Mgr., Societe Autocalor. PROPOSERS: E. M. May, R. C. Cross. SECONDERS: K. C. Richmond, A. P. Kratz.

KAPLAN, MALCOLM J., Htg. Engr., Veterans Administration Construction Service. PROPOSERS: Samuel Epstein,* W. P. Werendorff.* SECONDERS: M. M. Schechet,* H. M. Anderson.*

KELLY, EDWARD L., Mech.-Elec. Engr., Federal Public Housing Authority. PROPOSERS: G. M. Simonson, C. E. Bentley. SECONDERS: N. H. Peterson, G. K. Brokaw.

KELLY, LESTER R., Cons. Engr. PROPOSERS: J. S. Earhart, J. F. Park. SECONDERS: R. M. Gunzel, F. L. McDonald.

KEMSLEY, JOHN A., Mgr., Htg. & Vent. Dept., Reunert & Lenz, Ltd. PROPOSERS: G. N. Haden, W. W. Nobbs. SECONDERS: W. N. Haden, L. C. Watts.

KENDRICK, A. E., Dist. Mgr., Pacific Coast Heating & Appliance Co. PROPOSERS: E. Lokey, J. B. Banks. SECONDERS: M. W. Pysher, T. C. Langdon.

KENDRICK, G. N., Dist. Mgr., American Blower Corp. PROPOSERS: O. L. Lilja, R. W. Otto. SECONDERS: A. L. Sanford, W. F. Uhl.

KIRKWOOD, RODERICK R., Instructor, Eastern Signal Corps Schools. PROPOSERS: C. W. May, R. D. Morse. SECONDERS: John Baker, A. V. Hutchinson.

KIRKWOOD, T. A., Sales Engr., American Radiator & Standard Sanitary Corp. PROPOSERS: Karl Selden, Jr., R. E. Mason. SECONDERS: W. M. Wallace II, E. S. deWitt.

KITCHEN, FRANCIS A., Pres., American Warming & Ventilating Co. PROPOSERS: F. C. McIntosh, L. T. Avery. SECONDERS: J. E. Wilhelm, Paul Gayman. *(Advancement)*

KOPER, CHARLES H., Sales & Field Engr., B. F. Sturtevant Co., Div. of Westinghouse Electric Corp. PROPOSERS: Philip Cohen, G. B. Priester. SECONDERS: H. L. Repp, J. E. Wilhelm.

KRAUSE, LIN J., Minneapolis-Honeywell Regulator Co. PROPOSERS: J. E. Haines, Lyman Gross. SECONDERS: B. F. McLouth, E. F. Snyder, Jr.

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Candidates Elected

In the past issues of the JOURNAL of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and ballotted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, *Section* 8, of the By-Laws, the following list of candidates elected:

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DES REIS, JOHN F., Pres., Refrigeracion Industrial, S. A., Mexico, D. F., Mex[illegible]o. *(Reinstatement)*

FELLOWS, J. R., University of Illinois, Urbana, Ill. *(Reinstatement)*

GHILLARDI, FERNAND, Chief Engr., La Regulation Automatique, Paris, France. *(Reinstatement)*

KERR, A. W., Owner, A. W. Kerr & Assocs., Chicago, Ill. *(Reinstatement)*

KNAPP, JOSEPH H., Mgr., Knapway Devices, Inc., Kansas City, Mo. *(Reinstatement)*

MCKEEMAN, CLYDE A., Asst. to Pres., ASHVE, Cleveland, Ohio. *(Reinstatement)*

MCLAIN, ROLAND D., Vice-Pres., E. Keeler Co., Williamsport, Pa. *(Reinstatement)*

PARKER, DUDLEY F., Morristown, N. J. *(Reinstatement)*

SANDERS, WILLIAM R., Air Cond. Engr., Allen N. Dryden, Kingsport, Tenn. *(Reinstatement)*

VIESSMAN, WARREN, The Institute of Inter-American Affairs, Guatemala City, C. A. *(Reinstatement)*

YARBOROUGH, T. R., Y-B Refrigeration & Air Conditioning Co., Inc., Clearwater, Fla. *(Reinstatement)*

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LEVENTHAL, B., Controldtemp Equipment Sales Co., Brooklyn, N. Y. *(Reinstatement)*

LOCKHART, CHARLES W., Buffalo Forge Co., San Francisco, Calif. *(Reinstatement)*

MINOR, FRED K., American Air Filter Co., Cleveland, Ohio. *(Reinstatement)*

MULCEY, PAUL A., Anthracite Institute, Primos, Pa. *(Reinstatement)*

RIDDLE, KEMBLE L., Blaw-Knox Co., Blawnox, Pa. *(Reinstatement)*

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Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, O. A. Trostel, Route No. 2, Thiensville. Secretary, J. R. Vernon, 507 E. Michigan St., Milwaukee 2.

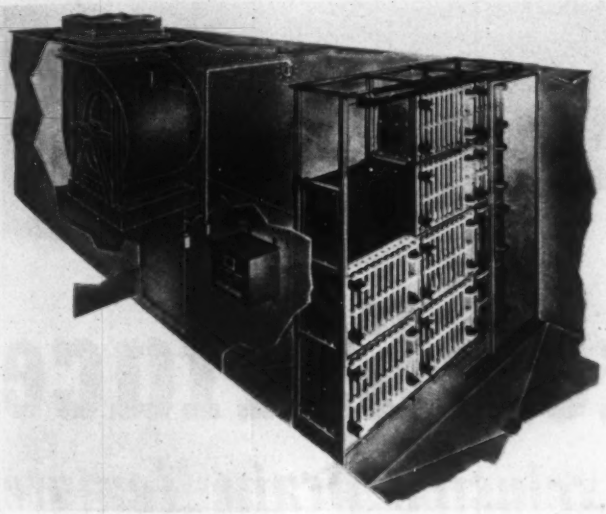
• EQUIPMENT DEVELOPMENTS •

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1946 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Electrostatic Dust Precipitator

No. 3086—Now in production at the Industrial Electronics Div., Raytheon Mfg. Co., Waltham 54, Mass., is a new electrostatic dust precipitator.**

The rectifier converts 110 volt a-c power supply to 12,000 volts d-c for ionization and to 6000 volts d-c for precipitation. The ionizer places a positive charge on dust laden particles which are carried by the air stream to the collector where the positively charged particles precipitate on to negatively charged plates. Since the power unit or rectifier, the ionizer, and the collector cell are each available in two sizes, various combinations of sizes and numbers of component parts provide a wide range of capacities up to 144,000 cfm.



According to the manufacturer, these units, which are designed to remove dust, smoke, pollen, oil mist, and other contaminating particles, will remove 90 per cent or more of all air borne dirt when installed in duct systems of industrial air circulating and air conditioning systems.

Two package units, which include the blower, are available for smaller installations. One of these units is designed to handle 1200 cfm and the other is rated at 1800 cfm.

Bellows Type Differential Flow Meter

No. 3087—The Bristol Co., P. O. Box 1790, Waterbury 91, Conn., has announced the addition of a bellows, differential flow meter to its line of mercury manometer flow meters.

The new instrument will be made as a mechanical flow meter, as an electric flow meter, and as a pneumatic, transmission flow meter in a line of recording, indicating, integrating, and automatic controlling models.

The meter body, operating on a new principle, requires no mercury in its operation. A unique method of transmitting bellows motion to the pen arm is employed, and the meter body shaft is isolated from the measured fluid.

Sturtevant Reorganization Announced by Westinghouse

No. 3088 — The manufacturing and engineering facilities of the B. F. Sturtevant Co., purchased by Westinghouse Electric Corp. in September 1945, are being integrated with the facilities of the latter company's air conditioning division which has been transferred from Jersey City, N. J., to the Sturtevant main plant at Hyde Park, Boston.

Ellis L. Spray, Westinghouse vice-president in charge of the elevator and air conditioning divisions of the corporation at Jersey City, has been elected executive vice-president of the new organization, which is known as the B. F. Sturtevant Co., Div. of Westinghouse Electric Corp.

G. C. Derry, formerly vice-president of the Sturtevant Co., has been elected vice-president and general manager. E. B. Williams, formerly vice-president of the Sturtevant Co., continues in that office with responsibility for continued development of the power and marine activities of the new subsidiary.

In addition to air conditioning the new subsidiary will carry on the Sturtevant business in forced and induced draft blowers for power plants, marine applications of fans and blowers, helical flow turbines, multiple air washers, speed heaters, factory heaters, dust collectors, railway air conditioning, and general industrial air handling equipment.

Other manufacturing and assembly activities will be continued at former Sturtevant plants at Camden, N. J., La Salle, Ill., Berkeley, Calif., and Galt, Ontario. The 42 offices of the Sturtevant Co. will be retained and coordinated with Westinghouse distribution points and personnel.

[*Continued on p.* 172]

Heating, Piping & Air Conditioning, [4-46]
6 N. Michigan Ave., Chcago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature.

(Circle each number in which you are interested)

3086	3087	3088	3089	3090	3091	3092	3093	3094	3095
3096	3097	3098	3099	3100	3101	3102	3103	3104	3105
3106									
6113	6114	6115	6116	6117	6118	6119	6120	6121	6122
6123	6124	6125	6126	6127	6128	6129	6130	6131	6132
6133	6134	6135	6136	6137	6138	6139	6140	6141	6142
6143	6144	6145	6146	6147	6148	6149			

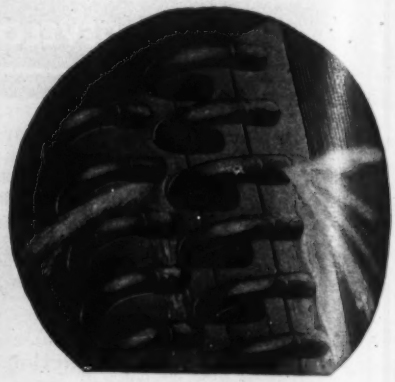
Name..... Title.....

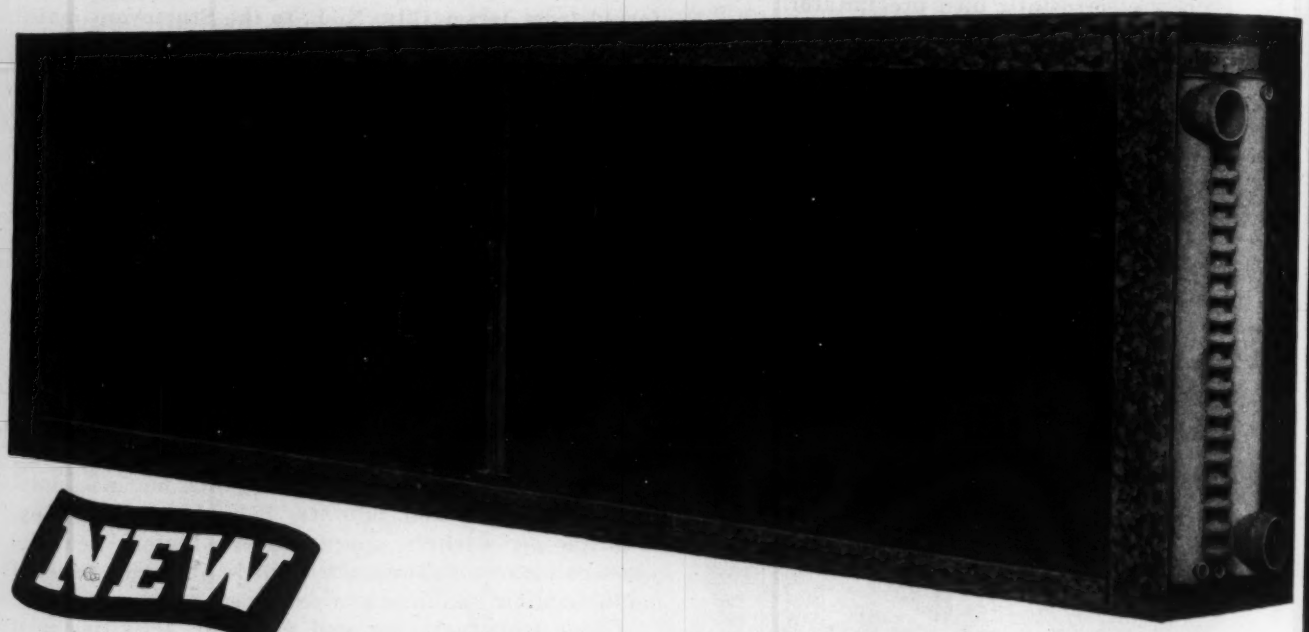
Company .....

Address .....

City..... Zone ..... State.....

Protect Your Cooling Surface against Freezing!

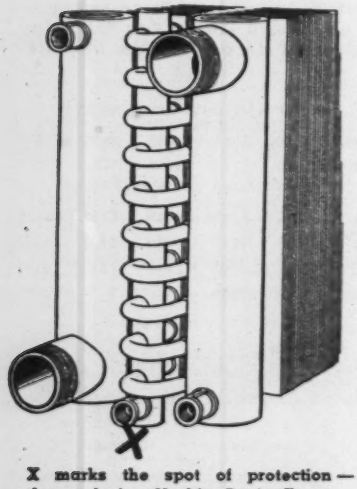




NEW

Nesbitt Water Surface

Pitched in the Casing • Exclusive Drain Feature



X marks the spot of protection — the exclusive Nesbitt Drain Feature.

GIVE A THOUGHT to your cooling surface for this summer and prevent costly freeze-ups next winter! Continuous tube, or "serpentine" surface is good. It is compact and it eliminates expensive field manifolding. But unless some easy means of drainage is provided, the trapped water may freeze and burst the tubes in cold weather. "Self-draining" surface that presumes a perfectly level installation is only a wishful thought. The real answer is the new Nesbitt Water Surface that is pitched within its casing and has the exclusive Nesbitt Drain Feature. This permits complete drainage through the inlet, outlet and drain headers. These important Nesbitt features may save you many dollars and headaches. Investigate. Send for Publication 246.

NESBITT HEATING AND COOLING SURFACES

Made by John J. Nesbitt, Inc., State Road and Rhawn Street, Philadelphia 36, Pa.
Sold by Leading Manufacturers of Fan System Apparatus

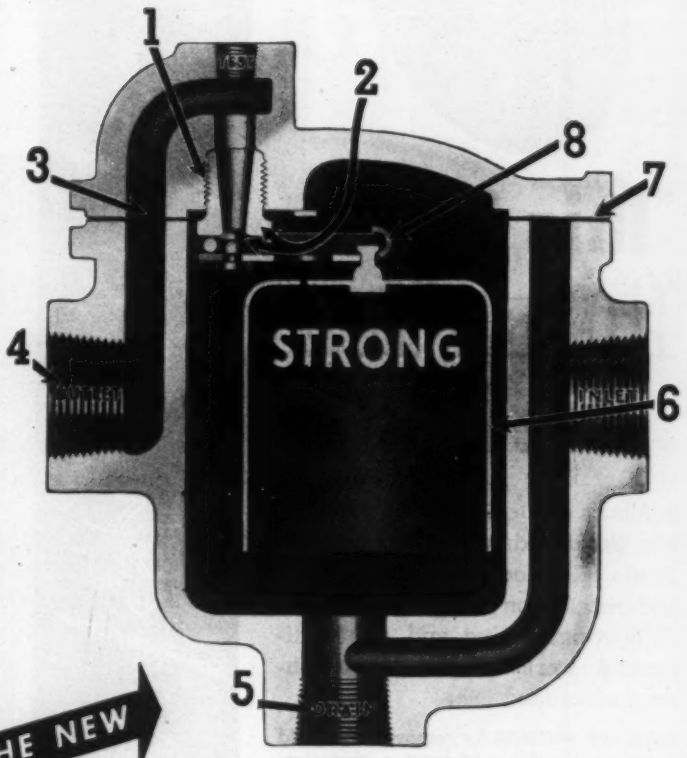
Eight Improvements

GENUINE make STRONG 70 Series Traps Better than Ever!

Look at these new features:

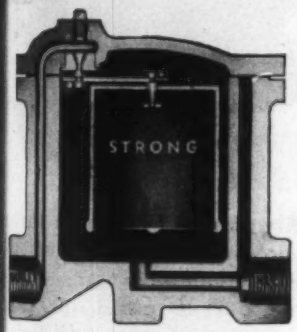
1. Renewable seat replacing pressed-in design;
2. Anum-Metl* valve and seat with new scientifically designed Hi-Cap* (patent applied for) orifice . . . up to 25% greater capacity;
3. Oversize inlet and outlet ports—increased flow capacity;
4. Relocated inlet and outlet connections—avoids backflow on light loads;
5. Drain connection added—available for bottom inlet;
6. One-piece, deep-drawn, stainless bucket—no welds;
7. Larger gasket area—means positive seal;
8. New, improved, stainless, high-ratio leverage.

Plus Adaptability to older models with change-over assembly including Hi-Cap orifice.



New 70 Series Strong Trap, No. 170

COMPARE THE NEW WITH THE OLD



Old 70 Series Strong Trap

In improving the 70 Series trap, Strong has remembered the thousands of older style 70 Series traps still in service after many years. Each improvement bears the "proof in service" label, so Strong quality remains uniformly high. Service continues to be available on all Strong traps, and they can be completely modernized to include the improvements listed above.

With a complete line of Strong open and inverted bucket traps at their disposal, Strong engineers can specify exactly the right type of trap for your particular application. For full details, write for the new Strong Catalog No. 67.

STRONG, CARLISLE & HAMMOND COMPANY, Cleveland 13, Ohio

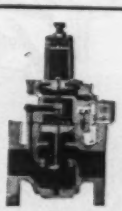
*Registered Trade Mark

REG. TRADE MARK

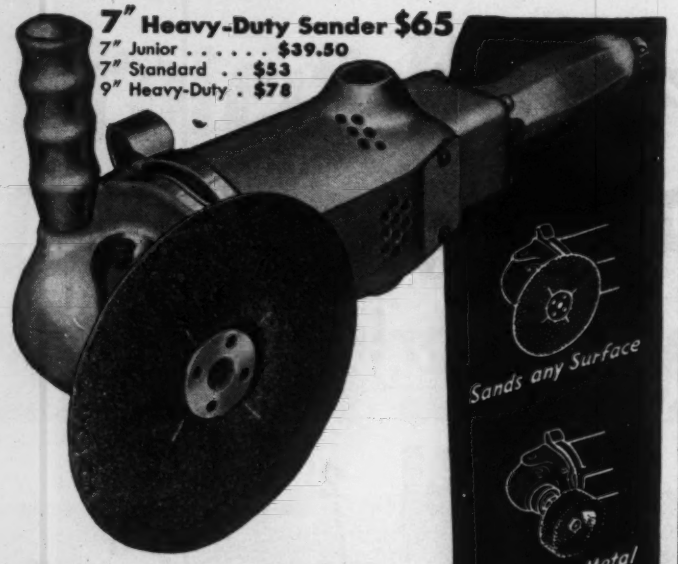
OTHER ANUM-METL Reg. Trade Mark **STRONG** STEAM SPECIALTIES

Strainer

No. 80 Series Trap



Reducing Valve



This One POWER TOOL Does All••

A Black & Decker Portable Electric Sander drives many attachments . . . does many fabrication and installation jobs . . . on all types of heating, piping and air conditioning work. Available attachments include:

WIRE CUP BRUSHES for removing rust, old paint, scale, light weld spatter, oxidation, grease or tar.

ABRASIVE DISCS in 19 different grains, for sanding and smoothing any surface.

GRINDING WHEELS for smoothing welds and castings, surfacing concrete, stone or tile.

ROTARY PLANER HEADS for shaping and semi-finishing lumber—jobs formerly done with jack plane and adz.

Order now from your Black & Decker Distributor, or write to: The Black & Decker Mfg. Co., 628 Penna. Ave., Towson 4, Md.

LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker

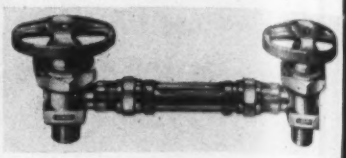
PORTABLE ELECTRIC TOOLS

[*Continued from p.* 163]

Packless Valve Gage Set

No. 3089*—Henry Valve Co., 3260 W. Grand Ave., Chicago 51, Ill., has announced the development of a new gage glass set featuring the company's diaphragm packless valves.

The new set is recommended for installation on accumulators, liquid receivers, oil reservoirs, etc., and is said to be particularly useful for installations in which there is surging or splashing within the vessel. If the glass tubing should be accidentally broken while the valves are open, a safety ball check in each valve operates to keep the liquid from escaping and to maintain pressure in the vessel. Additional safety is afforded by a slotted metal guard which protects the tubing while providing a clear view of the liquid column.

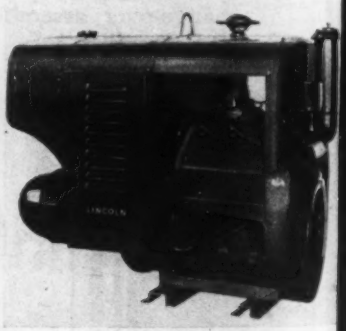


Forged brass valve bodies and fittings with ½ in. mpt screw ends are used. Tubing is rated at 500 psi (cold) for lengths up to 10 in.; 420 psi, 11-20 in.; 340 psi, 21-24 in. Horizontal valve outlets are 15 in. center to center standard, and the standard tubing length is 12 in. Other lengths may be had on special order.

Portable Gasoline Engine Driven Welder

No. 3090—A new portable welder, the "Shield-Arc Jr.," of the gasoline engine-driven type is offered by the Lincoln Electric Co., 12818 Coit Rd., Cleveland 1, Ohio.

According to the manufacturer, this welder is designed "to bring to the welding industry for the first time a very inexpensive, complete, light weight, portable welder for the price normally paid for the welding generator alone." It is said to be of particular value for applications where electric power is not readily available such as farms, oil and gas fields, construction work, etc. This 200 amp unit measures 24x48x30 in. and weighs 660 lb. Provision is made on the output panel for three ranges of output current, continuous adjustment within these ranges being obtained by a simple speed control. In addition, the speed of the air cooled engine determines the welding current which is controlled by adjusting the engine rpm between a maximum of 2100 and 1500.

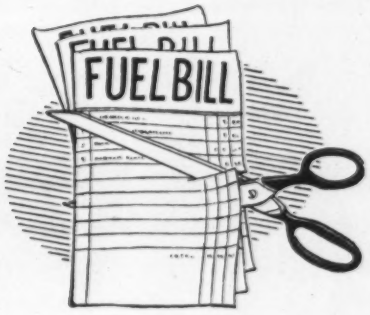


Temperature Control For Buildings

No. 3091—The "Weather-Man," which is actuated by outside temperatures and is designed to control the heating of buildings, has been developed by the**

Economical

IN **COST OF OPERATION**



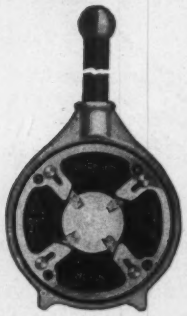
No. 3 in a series of
National Heat Extractor Boilers

Typical of their engineering quality is the ability of National Heat Extractor boilers to deliver maximum heating comfort with a minimum of fuel. Comparable in performance when fired by coal, gas or fuel oil, National Heat Extractors are easily converted from one fuel to another.

The No. 3 Series Heat Extractor boiler illustrated is especially adaptable to large homes or commercial installations. Remember too—there's an NRC heating product to fit every building need!

The NATIONAL RADIATOR Company

JOHNSTOWN, PENNSYLVANIA



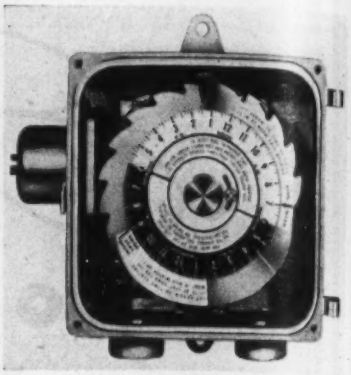
It stands up handily on the floor.

● This modern threader is always ready to cut perfect threads on 1", 1¼", 1½" or 2" pipe. One set of chasers that stay in the die stock adjust to size in 10 seconds—work-holder sets instantly, no bushings. Precision-made in all 23 of its rugged steel-and-malleable parts, it gives you micrometer perfect threads with least possible effort—and quickly. To cut smooth threads more easily—ask your Supply House for the efficient RIDGID No. 65R.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

Weather Controls Div., Automatic Devices Co., 53 W. Jackson Blvd., Chicago 4, Ill.

The time at which heating starts in the morning and the time at which it is shut down at night are automatically changed as the weather becomes warmer or colder. During the day, building temperatures are controlled by providing intermittent heating periods at regularly spaced intervals with the length of the heating periods being varied in accordance with changes in outside temperature. All heating stops when the outdoor temperature is above 65 F.



The manufacturer states that the device is as simple to install as the common day-night switch, that it combines the functions of several instruments in one unit, and provides the advantages of outside control at relatively low cost. This device may be used to operate any gas or oil burner, stoker, circulating pump, fan, motor valve, or zone valve.

City Bus Air Conditioned

No. 3092—The Carrier Corp., 302 S. Geddes St., Syracuse 1, N. Y., has announced that the world's first air conditioned city bus has been enthusiastically approved by passengers in San Antonio, Tex.

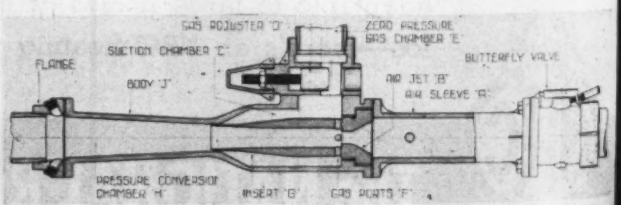
To maintain the comfort of 36 passengers in this bus, built by ACF-Brill, the system distributes cooled, filtered, and dehumidified air by means of a perforated duct in the ceiling. Outside air is drawn into the system to provide proper ventilation.

In response to the praise given this gasoline driven bus, the San Antonio Transit Co. has ordered 50 more for delivery early this summer.

Mixer for Air and Low Pressure Gas

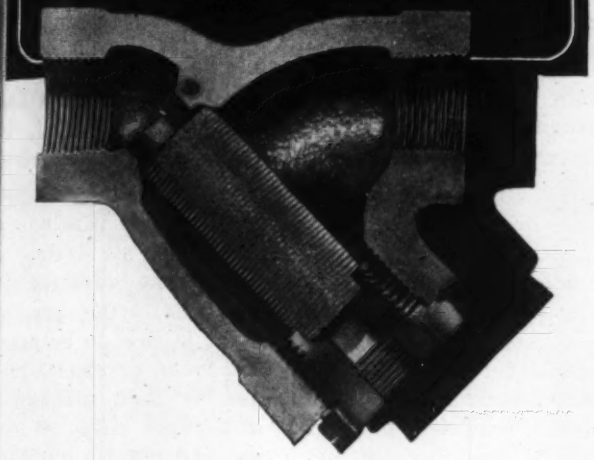
No. 3093—Production of the "Flomixer," a newly designed constant ratio mixer for low pressure air and gas, has been announced by the Bryant Heater Co., 17825 St. Clair Ave., Cleveland 10, Ohio.

First in a series of new gas combustion elements for use in industrial process equipment, the device utilizes the energy of a stream of air at pressures up to 3 lb to entrain a combustible gas and to deliver the mixture at relatively high pressure to the burner.



Available in pipe sizes from ¾ to 4 in., this venturi type mixer is said to provide an efficiency almost 50 per cent greater than that of presently available

It says "STOP" to Solids– "GO" to Fluids

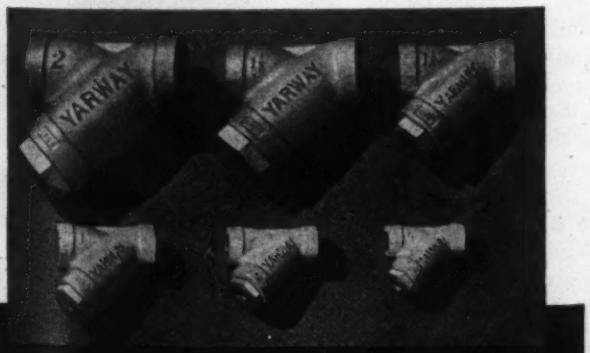


A BETTER Strainer to "police your pipelines"

- **FIRST**—*The Screen*, a high-grade woven Monel wire basket that catches solids—lets condensate, oil or other fluids flow freely.
- **SECOND**—*Finish*. Cadmium plated for protection against corrosion and for better appearance.
- **THIRD**—*Easily Cleaned*. Blow-off bushing made for easy removal. Bushing and screen come out together. Screen automatically aligns on reassembly.
- **THOUSANDS IN SERVICE**—Sold by over 100 Mill Supply Houses.

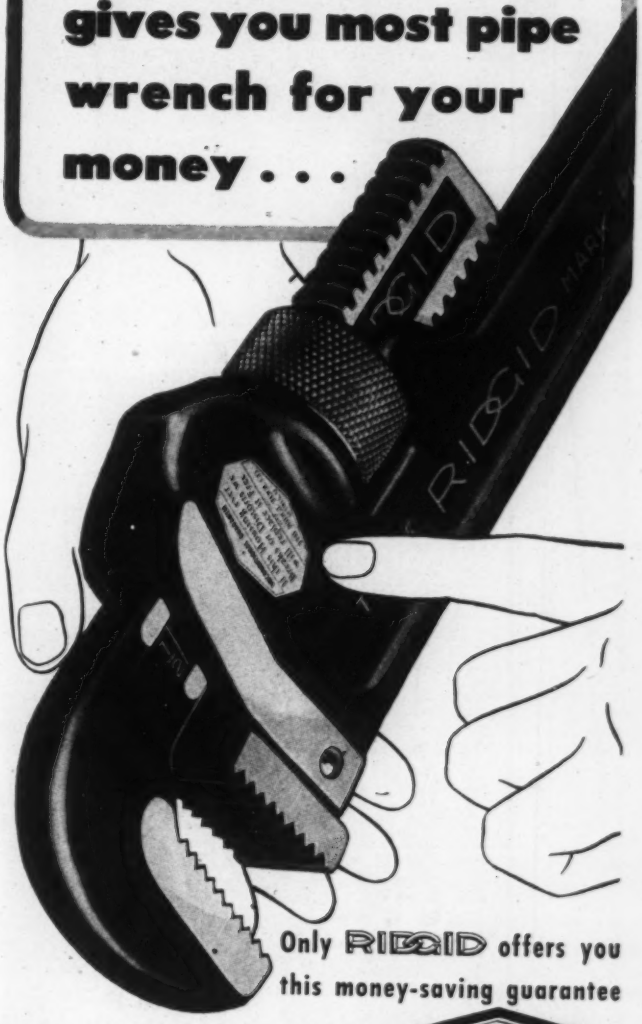
6 sizes from ½" to 2" for pressures up to 600 lb. Reasonably priced. See your supply house or write for Bulletin S-201.

YARNALL-WARING COMPANY
107 MERMAID AVENUE • PHILADELPHIA 18, PA.



YARWAY STRAINERS

This famous RIDGID gives you most pipe wrench for your money . . .



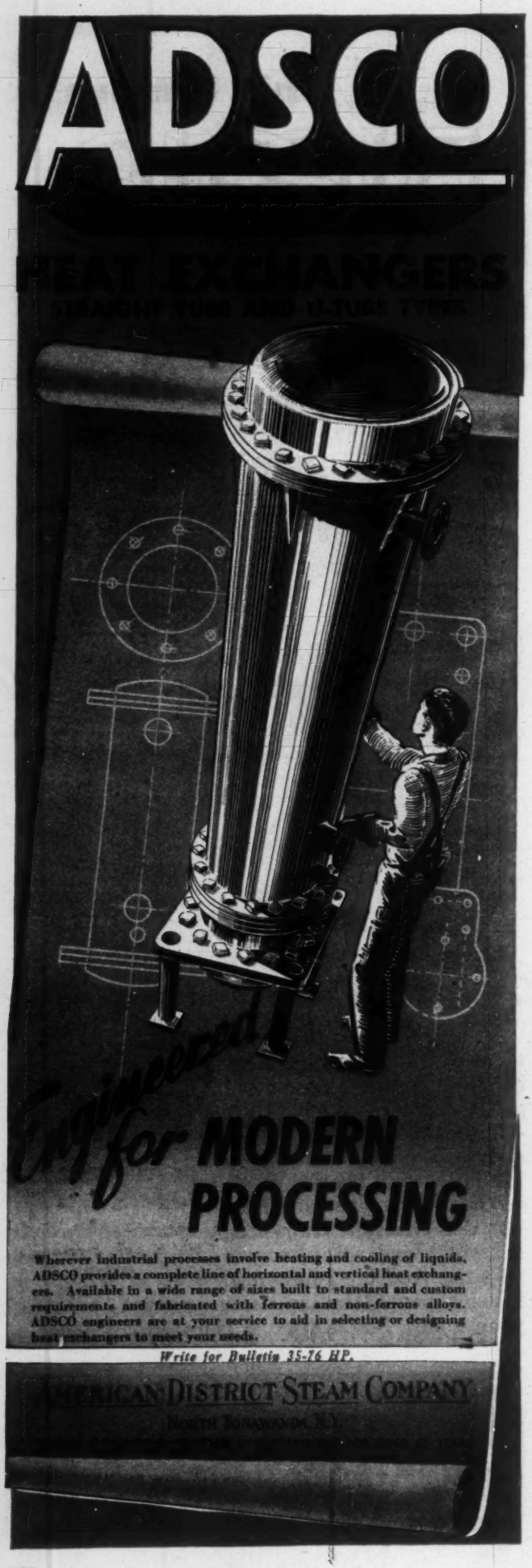
Only RIDGID offers you this money-saving guarantee

UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
COPR. 1937
THE RIDGE TOOL CO.
ELYRIA, O.

• You get a powerful I-beam handle so comfortable you can give it all the pull you've got — *barehanded*. Precision-cut alloy jaws take-hold and let-go instantly — full-floating hook-jaw has handy pipe scale, heel-jaw is replaceable. Adjusting nut won't bind, spins freely in all sizes. And the guaranteed housing means long expense-free service — most for your money. Buy RIDGID at your Supply House.

RIDGID *End Wrench for pipe in coils, against flat surfaces.*

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.


ADSCO
HEAT EXCHANGERS
STRAIGHT TUBE AND U-TUBE TYPES
Engineered for MODERN PROCESSING
Wherever industrial processes involve heating and cooling of liquids, ADSCO provides a complete line of horizontal and vertical heat exchangers. Available in a wide range of sizes built to standard and custom requirements and fabricated with ferrous and non-ferrous alloys. ADSCO engineers are at your service to aid in selecting or designing heat exchangers to meet your needs.
Write for Bulletin 35-76 HP.
AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.

equipment because of improved design of internal contours and proportions. An air supply of 1 lb pressure is said to produce a mixture pressure of 13 in. water with natural gas and 11½ in. with manufactured gas. The device is suitable for any type of gas from 550 to 3200 Btu, and according to the manufacturer, will maintain accurate gas-air ratios at all rates of flow providing zero pressure gas is supplied.

Protective Coating for Corrosion Problems

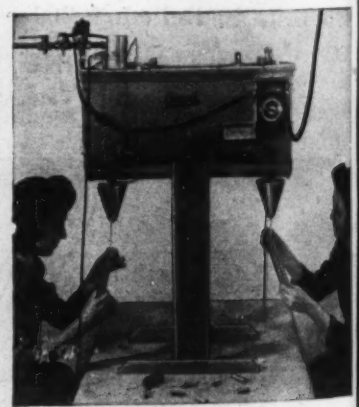
No. 3094—"Cotoid," which is based on a synthetic resin formula and which has been developed by the Lithgow Corp., 333 W. 40th Pl., Chicago 9, Ill., is offered as a protective coating for corrosion problems.**

The application of this material by spraying, dipping, flowing, or roller coating is said to result in a tough, hard, elastic finish, which, after air drying, is tasteless and odorless. Resistant to the corrosive action of acids, alkalis, chlorides, oils, brine, oxygen, gasoline, and alcohol solutions, it is said to be practicable for protecting walls and wood or steel structural work in such industries as food processing plants, wineries, breweries, and paper mills. It can also be used for coating inside and outside surfaces of concrete, steel, or wooden tanks. It will withstand a maximum air or vapor temperature of 220 F and a maximum submerged temperature of approximately 150 F. According to the manufacturer, it will not crack under temperatures as low as —20 F. While application by spraying is recommended, a special coating material is available for baking-on processes.

Process Tank for Heating Compounds

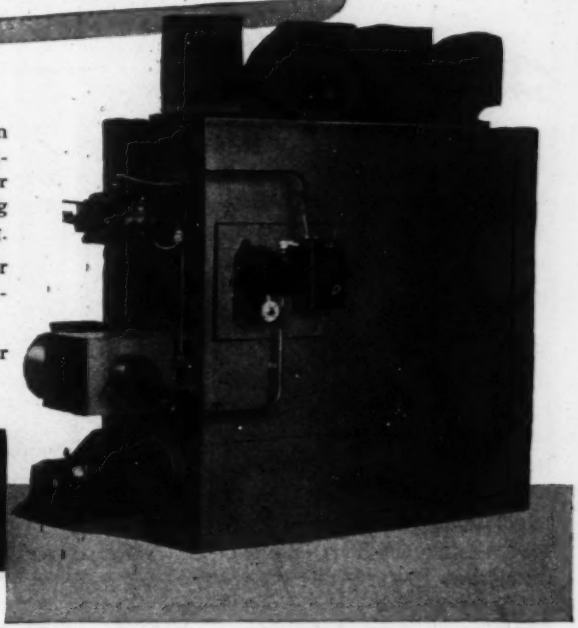
No. 3095—A gas fired, electrically controlled production tank for heating, melting, and pouring battery transformer, capacitor, and resistor compounds has been announced by the Aeroil Products Co., Park Ave. at 57th St., West New York, N. J.

This "Model 22TGT" unit is heated from the inside by means of a removable immersion tube system which is said to provide saving of 50 per cent in time, labor, and fuel. While the tank is gas fired, it is equipped with an electrically operated thermostat (temperature range from 100 to 550 F), a dial thermometer, and a safety pilot. Each of the two outlet valves is independently heated with the flame being directed on the spout opening. This, together with expanded metal strainers inside the tank, is said to provide proper temperatures throughout and to prevent freeze-ups and clogging. The liquid capacity of this model is 10 gal, but other sizes will soon be in production.



THE NEW AIRTHERM DIRECT FIRED WARM AIR HEATER

Costs Less to Install



The lighter weight of the new Airtherm Direct Fired Warm Air Heater means less structural work in installation, resulting in a saving in original installation costs. This lighter weight is particularly advantageous in installations calling for either vertical or horizontal wall or ceiling mounting.

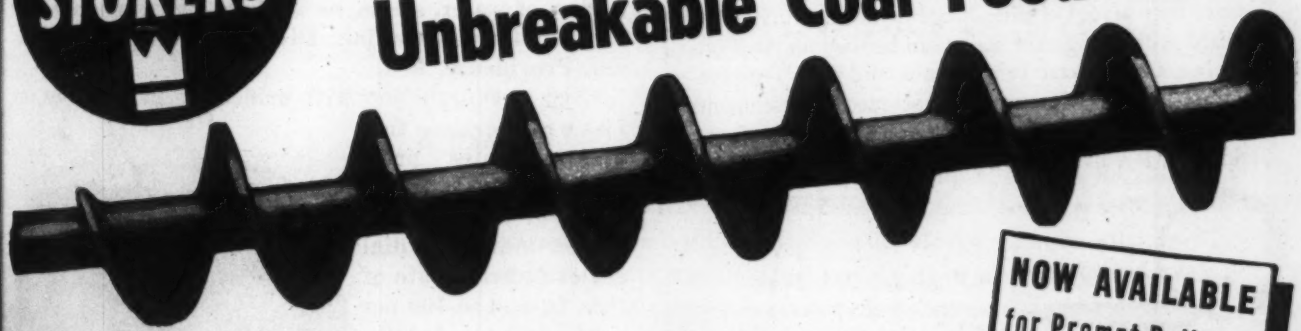
The low internal resistance through this new heater requires a minimum of motor horsepower, per B.T.U. output, reflecting a saving in power costs to the user.

Write for bulletin 801 describing the new Airtherm Heater in detail.

AIRTHERM
MANUFACTURING COMPANY
711 S. Spring Ave., St. Louis 10, Mo.

For STOKERS

The CROWN Unbreakable Coal Feed Screw



NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★ Crown's complete line of all-steel Coal Feed Screws meets every replacement and production requirement. Produced for both domestic and industrial stokers. Crown Screws are available with right or left hand screws, in all sizes and pitches, tapered or straight, and in combinations of pitches. Uniformly smooth surfaces insure that coal will flow freely and easily through the flights. Because it is all-steel with continuous weld, the Crown Coal Feed Screw guarantees long, continuous operation with full customer satisfaction. Crown is in a position to make prompt delivery on all sizes.

In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY
1202 Tyler St., N. E. *Since 1878* **Minneapolis, Minn.**

Shopping Comfort

. . . Defies Georgia's Summer Heat for Customers of Large Macon STORE* . . . With A-P VALVES Controlling the Cooling System.

Mr. H. L. Brown of Brown-Starr Electric Co., Macon, inspects store cooling system.

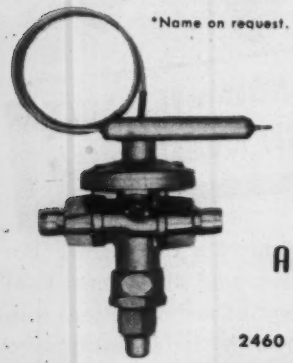
TEN YEARS of highly dependable service in controlling the cooling system of a leading chain store in Macon, Georgia, is credited to A-P Refrigeration Valves by Macon's Brown-Starr Electric Co. who services the installation.

Writes **BROWN-STARR'S Mr. H. L. Brown:**

"The job shown in the picture is the installation at a large store here in Macon. I have used A-P Valves on this job to control the cooling system for the last ten years. In the fifteen years I have been using A-P Valves, I have always found them to be very satisfactory."

Because they afford a wide range of adaptability, every standard A-P Refrigerant Valve can be used on Air Conditioning, Commercial Temperature, and Low Temperature installations without need for special attachments or for changing valves. This permits the use of one standard A-P Valve to fit a wide variety of applications.

*Name on request.



A-P Model 215 Thermostatic Expansion Valve. Capacity—up to 16.1 tons Freon and 32.1 tons Methyl Chloride.

AUTOMATIC PRODUCTS COMPANY

2460 N. 32nd St., Milwaukee 10, Wis.

DEPENDABLE *Refrigerant Valves*

Stocked and Sold by Good Refrigeration Jobbers Everywhere.
Recommended and Installed by Leading Refrigeration Service Engineers.

New Developments in Electronic Controls

No. 3096—Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., 4534 Wayne Ave., Philadelphia 44, Pa., has announced a series of new developments in the company's line of industrial electronic control instruments.

The developments include a front-set mercury switch type control for circular chart electronic potentiometers, a back-set mercury type auxiliary switch for both circular and strip chart electronic potentiometers, thermocouple and component failure protection for both electronic models, external chart drives, and omission of internal power switches.

According to the manufacturer, these will extend the uses to which electronic control instrumentation can be put, particularly in obtaining higher quality control through continuous balance rather than intermittent action, and will result in economies and speedier output. The new instruments, parts, and accessories include many variations for a specific industry or process.

Tap Extractors For Pipe Taps

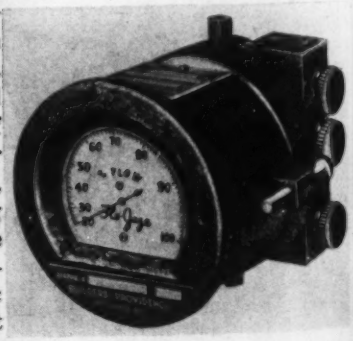
No. 3097—Ten new pipe tap extractors have been added as stock sizes by the Walton Co., 94 Allyn St., Hartford 3, Conn.**

Designed for accurate, quick, and ready removal of broken pipe-threading taps, these devices are similar to the company's line of extractors for hand and machine screw taps. Extractors for both regular and interrupted thread styles, sizes ⅛ to 1 in. are now available.

Flow Indicator

No. 3098—The "Flo-Gage" for indicating the rate of flow of water, steam, or air has been announced by Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.

Used in conjunction with orifices, venturi tubes, or insert nozzles, this unit indicates pressure differentials in terms of rate of flow. While standard dial scales indicate rate of flow from 0 to 100 per cent, special dials, with direct reading scales, are available for such units as gallons per minute, cubic feet per hour, etc. It may also be used for indicating liquid level or for measuring pressure differentials of 30, 60, 100, and 200 in. of water.



The gage mechanism is enclosed in a semi-steel chamber having a thick, pre-stressed window designed for an operating pressure of 500 psi and tested to withstand 2000 psi. This chamber is filled with a neutral transparent fluid. The high pressure line

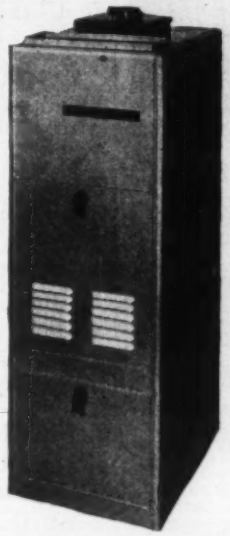
SYNCROMATIC

MODERN STEEL FURNACES

Maintains LEADERSHIP

with a complete and outstanding line of Modern Steel Furnaces COAL — OIL and NEW GAS » » » »

Write Your Nearest Jobber or Write Us Direct

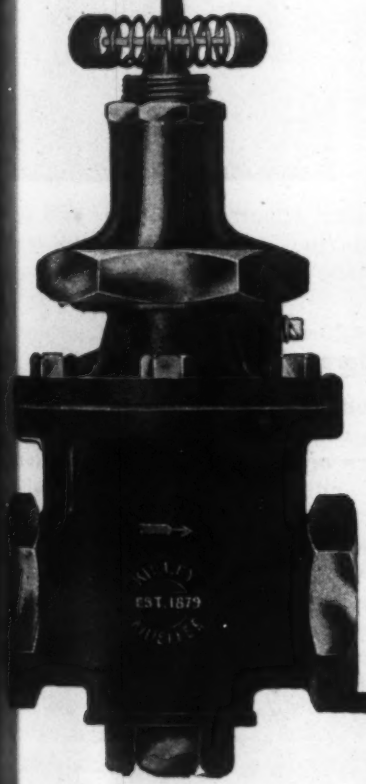


70,000 to 250,000 B.T.U.
Gravity or Forced Air
— COAL — OIL — GAS —

SYNCROMATIC CORPORATION

FACTORIES:
Milwaukee and
Watertown, Wis.

OFFICES:
5110 N. 35th Street
Milwaukee, Wisconsin



EXTREMELY ACCURATE REGULATION

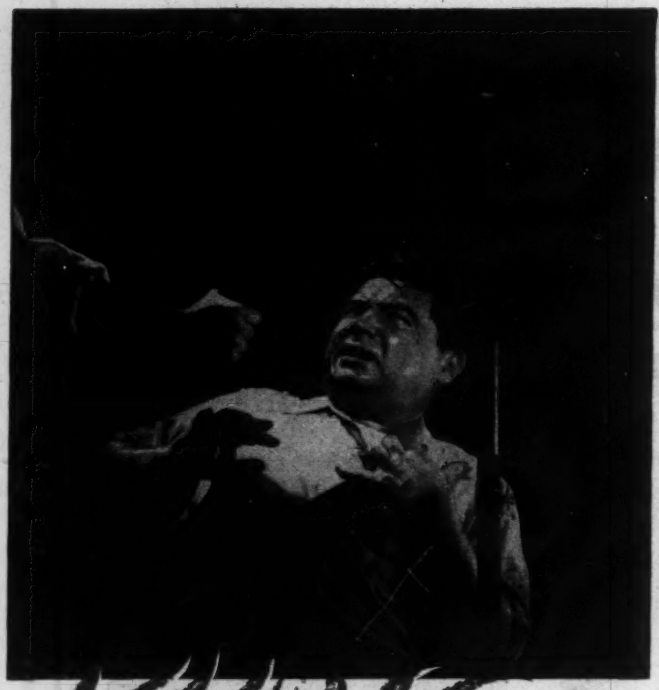
. . . EXTREMELY COMPACT IN SIZE

A fraction turn of the handwheel—and you can control *exactly* the pressure of steam passing through this very compact K & M Reducing Valve. Model 481 is widely used for difficult reduction service in industrial processes—and as a primary valve in double reduction installations. Self-contained . . . made in bronze . . . available in valve sizes of ½" to 2"—with 5⅜" the maximum overall measurement, face to face! Yet it accurately controls inlet pressures up to 250 lbs. . . . maintaining constant reduced pressures of 2 lbs. to 80% of the inlet. If you have a tough pressure reduction problem, perhaps K & M #481 is the answer. Our Engineering Department invites your inquiries.

Write for Catalog 66-C

KIELEY & MUELLER, INC.
MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS
2015 43rd ST., NORTH BERGEN, N. J.

Awarded our employees for outstanding production achievement.



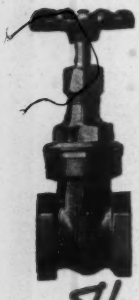
ON!

The third degree we're getting for our oldest plumbing items is really "something" (though not exactly like the picture, of course). Plenty uncomfortable, yet kind of flattering, too.

But here's the point . . .

We're anxious to produce the Gate and Radiator Valves we took over just before the war (former Eureka line). But with reconversion of our first few *plumbing items* taking our whole capacity—and still nowhere near enough—you can see why those items still have to be allotted . . . and also why we can't start our new Gate and Radiator Valves right now.

We're as anxious as you are to catch up with customers' needs . . . good service . . . prompt delivery. And, of course, you can count on the famous Eureka Gate and Radiator Valves on that basis as soon as possible. We still can't say exactly *when*. But just as soon as some of the heat is off of us, we can help you turn it on for your customers.



The Schaible Company

CINCINNATI 4, OHIO

from the primary element, or differential producer, leads to the operating bellows and the low pressure line leads to the inside of the chamber housing the entire gage.

Flux Coated Bronze Welding Rod

No. 3099—A new flux-coated bronze welding rod for use with the oxyacetylene flame has been developed by the Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

Known as "Oxweld No. 25M Flux-Coated Bronze Rod," this new product is said to speed up the welding operation and to facilitate the production of uniform welds of high quality. Since the flux melts continuously into the weld, the operator can give his entire attention to depositing the rod metal and to controlling the molten puddle.

When the rod is made, it is precoated with "Brazo Flux" in proportion to its size. The coating, which consists of a nonactive binder and which is said to be weatherproof, adheres firmly to the rod. According to the manufacturer, the rod can be heated and bent without destroying this coating.

Totally Enclosed Electric Motor

No. 3100—A new totally enclosed, fan-cooled motor, designed for use in extremely dusty, dirty, and corrosive atmospheres, has been announced by General Electric Co., Schenectady, N. Y.

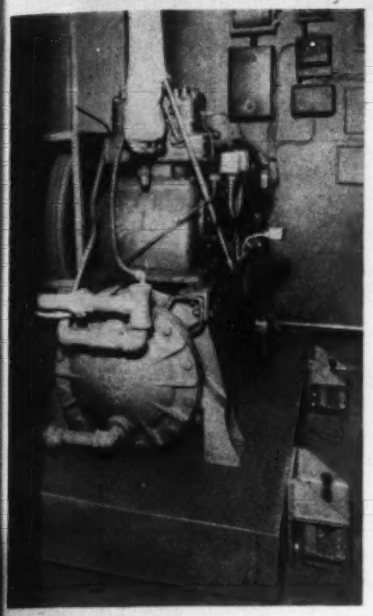
This new addition to the company's line of "Tri-Clad" motors is available in standard explosion proof and dust explosion proof types from 1 to 1000 hp. According to the manufacturer, this motor can be used where iron dust and metal filing are in the air and in class 1 groups C and D and class 2 groups E, F, and G hazardous locations. Because of compact construction, it is said to be suitable for machine tool applications where the motor must be part of the driven machine.

Accounting System for Contractors and Builders

No. 3101—An accounting system which combines the job record, payroll, cost information, and tax data with the accounting records has been designed for the use of contractors and builders by Tallman, Robbins & Co., Dept. 4, 314 W. Superior St., Chicago 10, Ill.**

Noteworthy features of the system include (1) the use of building terms and items in the forms themselves as well as in the instructions, (2) the inclusion of a "Job Memoranda" for jotting down important data for use in figuring future jobs, (3) a means of ready comparison of the actual costs with the estimated costs for each job, (4) adaptability for use by the small operator who keeps his own books or by the larger operator who desires a complete double entry

AIR CONDITIONING *Silenced* by KORFUND

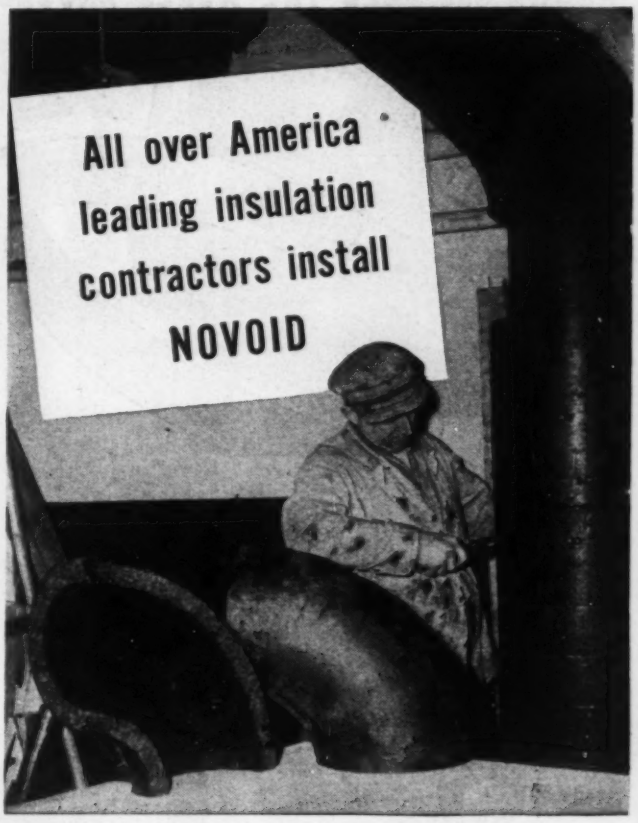


ADJACENT to a broadcasting studio on the eighth floor of a New York building, this 2-cylinder, 2,050 lb. compressor unit with speed of 650 RPM, 10 HP motor at 1,700 RPM, is installed on 1,800 lb. concrete slab, and side-mounted on four Korfund LK/D Vibro-Isolators with Elasto-Rib pads. These support the entire unit with no disturbing vibration or noise transmission.

EVERYONE knows that broadcasting studios have to be quiet. And since most broadcasting studios today are air-conditioned, Korfund Vibration Control must keep air conditioning noises *off the air*. Korfund meets this test of vibration and sound control with especially designed Vibro-Isolator Units.

Whether *your* air conditioning is in a restaurant, department store, hospital or theater, one of its benefits is quiet operation. Korfund Vibration Control is the answer to air conditioning operating disturbance. Contact Korfund today for a discussion of your vibration and noise transmission problem. No obligation, of course.

KORFUND
VIBRATION CONTROL
THE KORFUND COMPANY, Inc., 48-36 32nd Pl. LONG ISLAND CITY 1, NEW YORK



Mechanic for Robert A. Keasbey Company, New York City, installing ice water thickness Novoid Cork Pipe Covering on 12" lines of air conditioning system for Abraham & Straus, Brooklyn, N. Y., nationally known department store. The A&S store is shown as it will appear when new addition is completed.

YOU CAN NOW GET Novoid Cork Pipe Covering promptly through America's outstanding insulation contractors. In New York, the Novoid distributor is the Robert A. Keasbey Company, one of the oldest and most widely experienced firms in the business.

Novoid Covering is the moulded rigid insulation that efficiently reduces your cost of refrigeration. It snugly hugs pipes and fittings of every size and shape, does not sag, does not absorb moisture or odors, and is long-lasting.

For complete facts about Novoid Pipe Covering, Corkboard, and sundries especially developed to make low temperature insulations most efficient, write to Cork Import Corporation, 330 West 42nd Street, New York City.

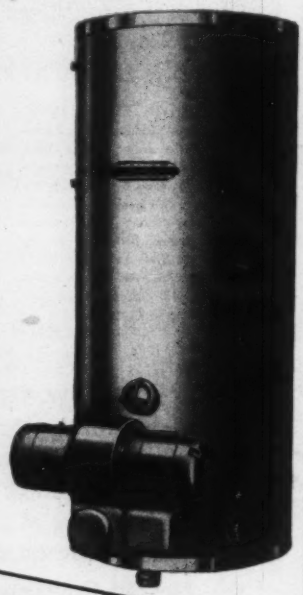
NOVOID INSULATION
CORKBOARD • PIPE COVERING

KNOWN and USED THE WORLD AROUND

Aldrich Oil Burners and Burner-Boiler Units were standard equipment in United States Insular Bases the world around. That's proof of unmatched efficiency, performance . . . All during the war, Aldrich Co. worked night and day at their regular job—producing extra-value burners and burner-boiler units . . . Post war improvements are facts—not promises—in Aldrich equipment.

HEAT-PAK Burners Models AX and BX

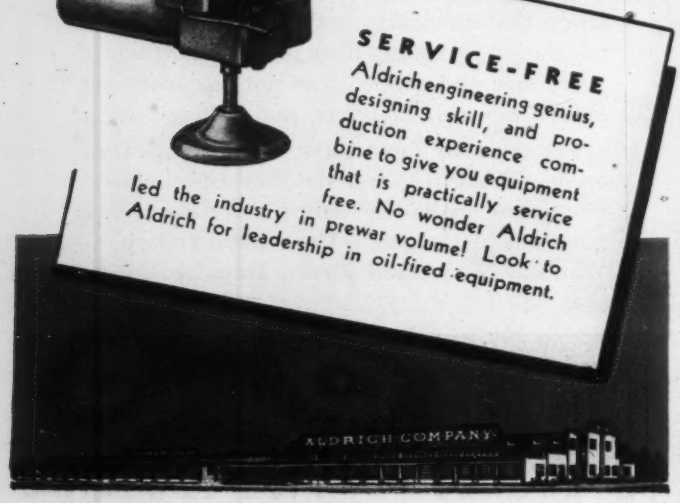
Embodying famous Aldrich features, HEAT-PAK Model AX (.75 to 5.00 G. P. H.) and Model BX (4.00 to 9.00 G. P. H.) are being produced as fast as materials become available . . . Production of famous HEAT-PAK Burner-Boiler Units and oil-fired Water Heaters is limited only by manpower and materials.



Aldrich
COMPANY
WYOMING, ILLINOIS

SERVICE-FREE

Aldrich engineering genius, designing skill, and production experience combine to give you equipment that is practically service free. No wonder Aldrich led the industry in prewar volume! Look to Aldrich for leadership in oil-fired equipment.

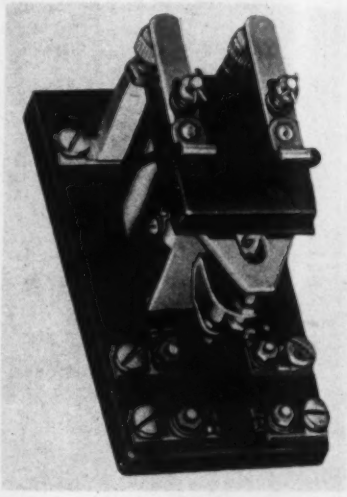


system (the latter merely includes a separate ledger and journal), (5) the incorporation of a percentage system for the determination of overhead and other indirect expenses, and (6) compliance with all internal revenue requirements.

Heavy Duty Relay

No. 3102—"Bulletin 130 Relays," designed for heavy duty industrial and electronic applications such as light contactor duty, control of single phase motors, and other remote or automatic control purposes, are offered by Ward Leonard Electric Co., Mt. Vernon, N. Y.

Moulded phenolic bases, accessible front connected terminals, corrosion resistant finish on all metal parts, silver relay contacts, and mechanical interlocks for reversing service are among the features included. Contact arrangements are available from one to four poles, normally open or normally closed, single or double throw. Operating voltages for direct current are from 6 to 230 volts and for alternating current from 6 to 440 volts. Contact ratings for d-c current are 25 amp, 0-24 volts; 3 amp, 25-125 volts; 1 amp, 125-300 volts. For 60 cycle a-c circuits the ratings are 25 amp, 0-250 volts; 15 amp, 251-440 volts.



Positive Displacement Pumps

No. 3103—"Flow-Master" pumps of the positive displacement type for handling light, volatile, or heavy, viscous fluids have been developed by the Marco Co., Inc., Wilmington 50, Del.**

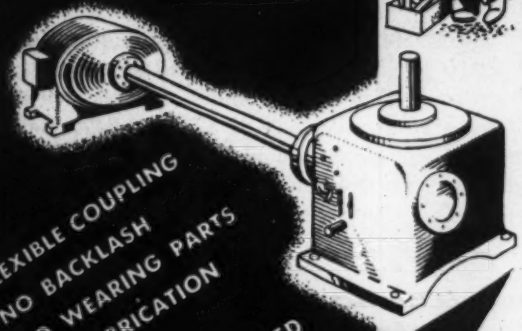
Developed some years ago for handling materials varying widely in density and viscosity, in connection with the company's line of homogenizing equipment, these pumps are now offered as separate units. According to the manufacturer, noteworthy features include (1) the ability to transfer, meter, or proportion when equipped with suitable speed reducers, (2) provision for automatic control of normal wear to maintain volumetric efficiency even when head pressure is increased, (3) long pump life together with a minimum in maintenance and renewal costs due to the use of hydraulically balanced rotors, (4) shaft seals of the single gland type housed in stainless steel armor which do not require adjusting, and (5) the ability to maintain a high vacuum.

These precision pumps are available in stainless steel or other stainless metal. Rotors and shafts are of special hardened stainless alloys and roller bearings run continuously in an oil bath. Four sizes are available in capacities ranging from 5 to over 400 gph.

L-H FEATURE

Maintenance Free

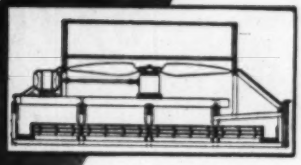
REDUCTION GEAR DRIVE SHAFT



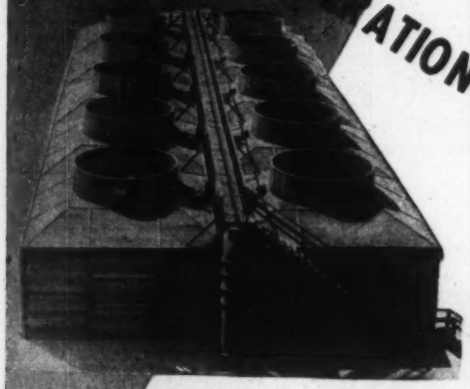
- FLEXIBLE COUPLING
- NO BACKLASH
- NO WEARING PARTS
- NO LUBRICATION

—

- TOTALLY ENCLOSED
- BALL BEARINGS
- WORM GEARS



CUTS POWER OPERATION COST



A feature — reason for low maintenance in L-H Induced Draft Towers.

Case records show 4-figure savings in many multi-cell installations.

Plus low pump and power cost from L-H open flume and gravity type operations... bed-rock low-cost operation for you.

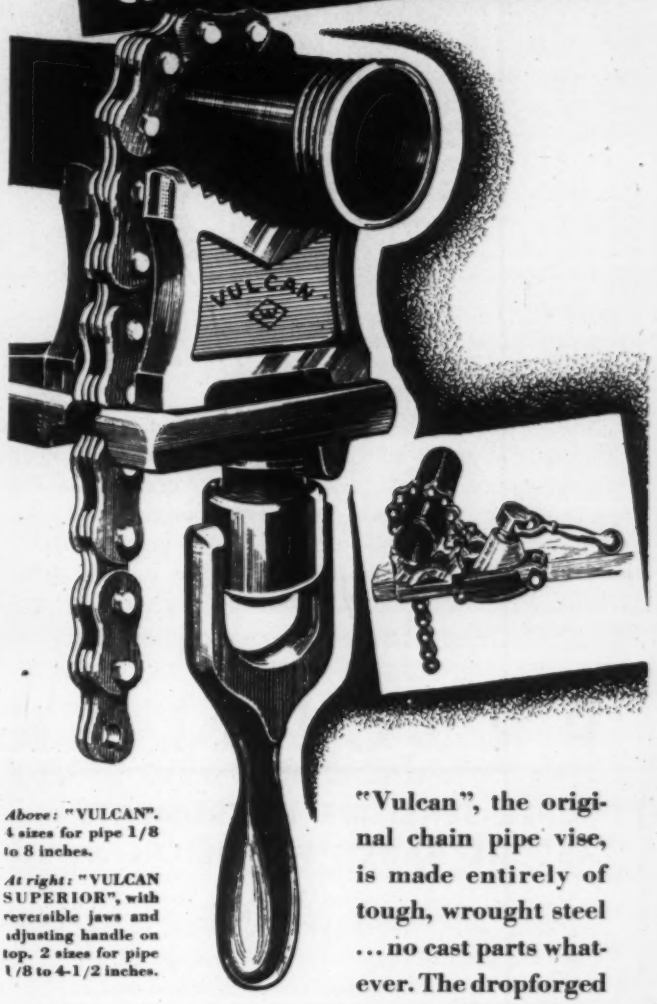
Write for Catalog 440-A.

Lilie-Hoffmann
COOLING TOWERS, INC.
Manufacturers of All Types of Water Cooling Towers
GENERAL OFFICE 4239 DUNCAN AVE., ST. LOUIS 10, MO.
PLANTS AT ST. LOUIS, MO. AND PLAINVIEW, TEXAS

WILLIAMS

SUPERIOR DROP-FORGED TOOLS

"VULCAN" Drop-forged CHAIN PIPE VISES

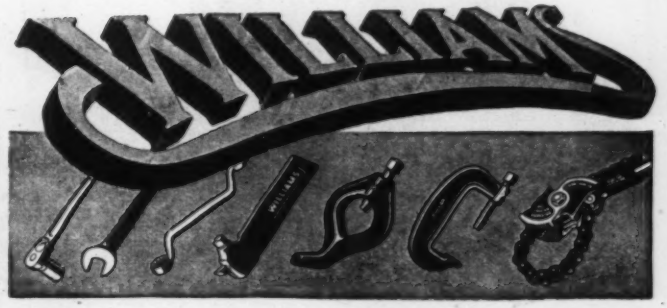


Above: "VULCAN". 4 sizes for pipe 1/8 to 8 inches.

At right: "VULCAN SUPERIOR", with reversible jaws and adjusting handle on top. 2 sizes for pipe 1/8 to 4-1/2 inches.

"Vulcan", the original chain pipe vise, is made entirely of tough, wrought steel ... no cast parts whatever. The dropforged jaws are of saw-tempered steel for file sharpening ... chains are of the same high quality as Williams' "Vulcan" Tongs. Fully guaranteed, and sold by Industrial, Plumbing and Oil Field Distributors everywhere.

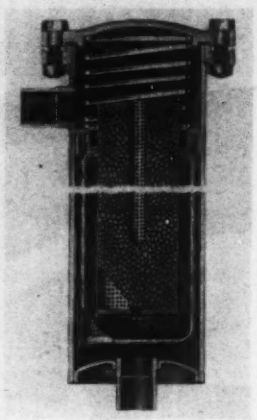
J. H. WILLIAMS & CO., BUFFALO 7, N. Y.



Combination Strainer, Filter and Drier for Mobile Refrigeration

No. 3104—Henry Valve Co., 3260 W. Grand Ave., Chicago 51, Ill., has announced the development of a combination strainer, filter, and drier designed especially for mobile refrigeration installations.

The new unit is designed to withstand the vibration and abuse encountered in railroad and truck installations. The dehydrator may be renewed with a factory-sealed dehydrant cartridge which has an inlet dispersion tube to prevent channeling of refrigerant through the drying agent. The filter is locked on the dehydrant cartridge by a snap ring, and the assembly is securely held in place by a compressed spring.



Specifications are: screen area, 136 sq in., volume of dehydrant, 50 cu in., size of tubing connections, 5/8 and 3/4 in., shell diameter, 3 1/8 in. It is recommended for use with systems up to and including 5 hp, and is shipped with inlet and outlet ports sealed with soft-soldered caps to protect interior of unit from moisture and dirt. Drier cartridges are packed in moistureproof containers when shipped separately. Standard drying agent is silica gel; other dehydrants are furnished on special order.

Stainless Steel Arc Welding Electrodes

No. 3105—Two improved electrodes for shielded arc welding of stainless steel have been announced by the Lincoln Electric Co., 12818 Coit Rd., Cleveland 1, Ohio.

"Stainweld A7," which was discontinued during the war, has been improved and is now being manufactured. It is recommended for use with stainless steels, AISI 304 and 308. It is said to produce a smooth and steady arc with easy slag removal and is suited for operation on d-c or the higher voltage type a-c welding units.

"Stainweld A7-Cb" is columbium stabilized and has operating characteristics similar to the foregoing electrode. It is recommended for use with stabilized 18-8 stainless steels, AISI 321 and 347. Both of these shielded arc electrodes are recommended by the manufacturer for weld-surfacing where an austenitic surface of medium hardness and good corrosion resistance is required.

Radiant Heating Company Formed

No. 3106—Charles Ellaby of Ellaby, Rixmann, and Turner, engineers and architects, 320 N. 4th St., St. Louis 2, Mo., has announced the formation of the Radiant Panel Corp., which is located at the same address.

The firm is offering individually designed radiant heating and cooling systems and is prepared to furnish complete plans for any installation.

PRECISION

SUPER-SENSITIVE INSTRUMENTS ASSURE BAKER PRECISION....

In the Baker laboratory, where designs become machines, the most modern and scientific equipment is used. Electronic balancing equipment—the Vibrascope and the Vibrameter eliminate vibration caused by inaccuracies as little as 1/10,000 of an inch. The Stethoscope is used to magnify and locate any noises below normal ear level. Thus, we safeguard Baker reputation—and assure the long life and *dependable* performance of Baker Machines.

Baker

ICE MACHINE CO., INC. OMAHA

MANUFACTURERS OF REFRIGERATION AND AIR CONDITIONING EQUIPMENT SINCE 1905

3-WAY GUARANTEE OF DEPENDABLE PERFORMANCE

Hydrovac

Super Vacuum Return Units

Not one, not two, but three guarantees highlight the quality and performance of Hydrovac units.

1. 3-year wear-proof guarantee.
2. Guarantee of a minimum of 25 inches of vacuum at 70° F. against a sealed inlet.
3. Guarantee that vacuum will not recede to zero, with unit at rest, in any time under 5 hours.

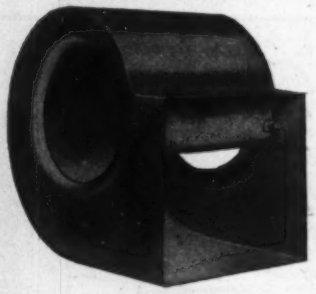
Note these features of Hydrovac's exceptional design and construction:

(1) Permoy Cast Iron Receiver; (2) Bronze Internal Parts; (3) Extra Large Shielded Bearings; (4) No Vacuum at Stuffing Box; (5) All facings machined; (6) Stainless Steel Rods; (7) Dash Pot Mechanical Valves; (8) Stainless Steel Bushings; (9) Wide Clearance Between Working Parts.

Get All the Facts Back of Hydrovac's Triple Guarantee. Write for the 4-page Bulletin 100-B.

AMES HYDROVAC INC.

290 SCHOLES STREET BROOKLYN 6, N. Y.



Massachusetts

WHEELS and HOUSINGS

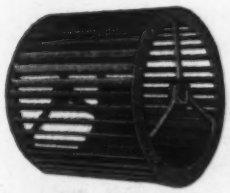
For Air Conditioning Product Manufacturers

HOUSINGS

For standard diameter wheels.
Single or double inlet.
Full or special width.
Special scroll design for restricted spaces.

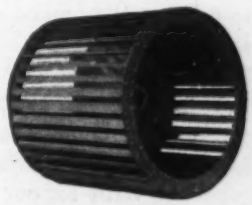
WHEELS

7½" to 27" diameter.
Single or double inlet.
Center plate or end spider.



TYPE "SP" WHEEL
SPIDER TYPE

TYPE "C" WHEEL
CENTER PLATE TYPE



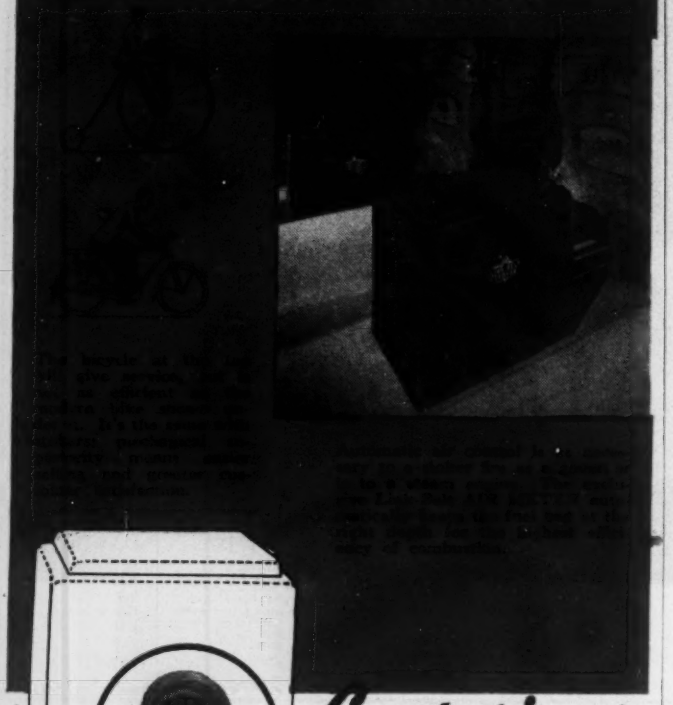
Bulletin 103 Catalog now available giving complete description, performance data and dimensions.

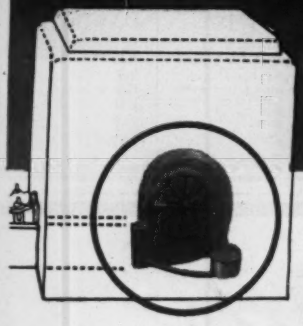
MASSACHUSETTS BLOWER DIVISION

The BISHOP & BABCOCK Mfg. Co.

4901 HAMILTON AVENUE · CLEVELAND 14, OHIO

EASIER SELLING . . LESS SERVICE . .
LONGER LIFE . . SATISFIED CUSTOMERS
through
MECHANICAL SUPERIORITY





Comparisons
ARE ODIOUS
....BUT NECESSARY

The mechanical features of an automatic coal stoker can make a great difference to a dealer or distributor, since they have a direct bearing on the profit he makes per dollar and per hour invested in the stoker business.

There *is* a difference in stokers, and the best way to find out is to make comparisons. We'll be glad to show you what the Link-Belt Stokers have on the ball, and how and why they are different. The Link-Belt line includes bituminous and anthracite hopper and bin-fed domestic models, and commercial and industrial stokers up to 1200 lbs. per hour coal feed capacity. Write for our proposition:

LINK-BELT COMPANY 10.287
Stoker Division
2410 W. 18th St. Chicago 8, Illinois

LINK-BELT Power-Flex
Magic Flame STOKERS

• RECENT TRADE LITERATURE •

For your convenience in obtaining copies of these bulletins, see coupon on page 163. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Conditioning.

Automatic Clutch

No. 6113—The Hardinge Co., Inc., York, Pa., has announced acquisition of manufacturing and sales rights for the "Auto-Centri" clutch from the Automatic Clutch Corp. of Canada, a subsidiary of the British Meter Co.

This device, described in a new bulletin (No. 45), is available in sizes from fractional horsepower to 5000 hp for any type of power drive. The manufacturer states that when installed with an electric motor drive, across-the-line starting equipment can be used.

Central Heating

No. 6114—An 8 page booklet, one of a series of case histories on central heating which is published by the Ric-Wil Co., 1562 Union Commerce Bldg., Cleveland 14, Ohio, describes the distribution of steam throughout the Firestone Tire and Rubber Co. plant at Akron, Ohio.

Photographs and sketches are used to illustrate the extensive layout and a discussion of providing steam for the new research laboratory, over a mile from the boiler plant, is featured.

RESISTS VIBRATION

Rugged—precision-built—resists vibration.
Time delay control ranging from a fraction of a second to several minutes. Setscrew adjusted.
Write for complete information and catalog. No obligation.

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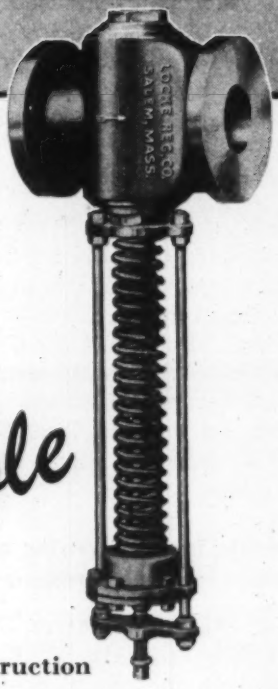
Electro-Pneumatic *TIME DELAY RELAY*
ELIZABETH A·G·A NEW JERSEY
AMERICAN GAS ACCUMULATOR COMPANY

LOCKE

REDUCING VALVE *and* PUMP GOVERNOR



Now Available

- ★ Rugged Construction
- ★ Extreme Range
- ★ Direct Acting
- ★ Uniform Reduced Pressure
- ★ Cast or Composition Bronze
- ★ Extreme Sensitivity
- ★ Compact Size
- ★ Operates Smoothly
- ★ Sizes up to 2″
- ★ True, Even Pressure

For use as pump governor it will be furnished with a stuffing box that usually lasts the life of the governor. Initial Pressures up to 250 lbs. Reduced to 10 lbs. with 20 lb. range.

A catalogue or consultant available at your request.

DIVISION OF THE H. T. WILSON MACHINE CO., INC

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PEACOCK BROS., LTD. • MONTREAL, CANADA
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STILL USING the sand-and-heat method to bend steel and wrought iron pipe? Then read what Philip E. Nolan, owner, Westport Plumbing & Heating Co., Kansas City, Mo., says about his GREENLEE Pipe Bender.

"Our GREENLEE saves us 50% working time on bends, cuts material spoilage 25%, and provides 66% saving on fittings and manufactured bends. In addition we get a neater job, and friction heads are cut 90% on long-radius bends."

Do the job easier, faster, *better* with a GREENLEE . . . one-man-operated, compact, portable . . . for on-the-job, smooth, *accurate* bending of pipe up to 4½″ size. Write today for complete information. Greenlee Tool Co., Division of Greenlee Bros. & Co., 2344 Twelfth Street, Rockford, Illinois.

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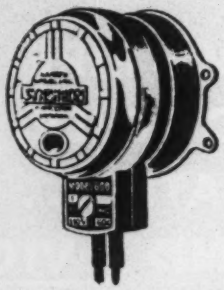
GREENLEE
FOR THE CRAFTSMAN



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You want controlled power—consistent power—for time controls and time switches. Power that is measured evenly with every electric impulse, giving utmost accuracy and reliability to the carefully geared machines you build. You get this power with

SYNCHRON

TIMING MOTORS AND TIME MACHINES

These power units are built to take it—with oil-impregnated double bearings, brass gears, hardened steel shafts—and a reputation for customer satisfaction that dates a quarter of a century.

SYNCHRON synchronous motors are small—only 2¾" by 1 5/16"—with power to pull 8 oz. direct load continuously at 1 RPM. This time-tested motor powers the SYNCHRON Time Machine, a compact little "timer" with a proved record for sustained accuracy and reliable service under all types of working conditions. For complete details, write

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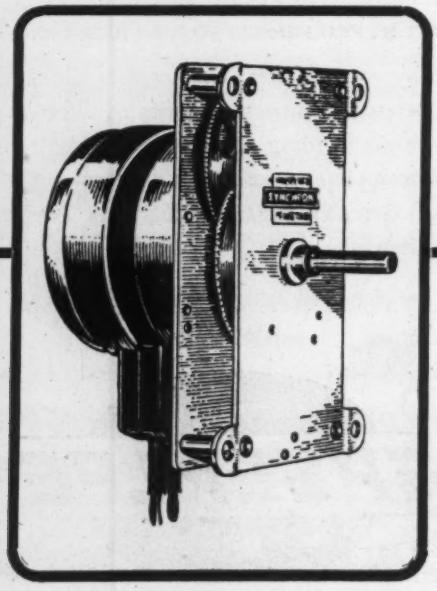

Combination Rivet And Nut Plate

No. 6115—The development of the "Rivnut" by the B. F. Goodrich Co., 548 S. Main St., Akron 18, Ohio, for attaching rubber de-icers to metal skins of airplanes is described in a new 10 page folder. This device, a one piece, internally threaded and counterbored tubular rivet, can be upset or headed from one side and can be used as a rivet, nut plate, or both. It is now available in brass, steel, and stainless steel with a number of head styles for many industrial applications.

Control Instruments for The Dairy Industry

No. 6116—The Bristol Co., P. O. Box 1790, Waterbury 91, Conn., has announced three new bulletins covering the company's line of instruments for the dairy industry. Bulletin T825 describes thermometers, both recording and mercury stem indicating types. Bulletin TA827 covers a high temperature, short time control system and bulletin T829 describes the company's line of flow diversion valves and milk flow thermal limit controllers.

Controls for Hot Water and Radiant Heating Systems

No. 6117—Sarcotherm Controls, Inc., 280 Madison Ave., New York 16, N. Y., has published a 36 page manual on controls and hook-ups for hot water and radiant heating systems.

How much fuel, energy and equipment could you save *by saving conditioned air?*

Converting 1000 CFM of stale, odorous air to fresh air with Dorex *activated carbon* Air Recovery Equipment, instead of bringing in and conditioning outdoor air, saves:

100,000 BTU of installed heating capacity
3 tons of installed refrigeration
1800 KW hours of current per cooling season
1500 gallons of fuel oil or
9 tons of coal per heating season
Incidental water consumption and maintenance

Per 1000 CFM of heated or cooled air saved

The above savings are figured for average temperate zones. Some installations have shown greater savings, some less. But in every case, Dorex Air Recovery has *converted contaminated air to fresh air* at a cost much below that required to replace it with an equal volume of outdoor air.

We will be glad to give you the details on actual savings in typical installations or estimate the savings on any existing or planned system. For full information call the nearest District Representative or write Dept. **D-9.**

W. B. CONNOR ENGINEERING CORP.

AIR DIFFUSION AIR PURIFICATION AIR RECOVERY

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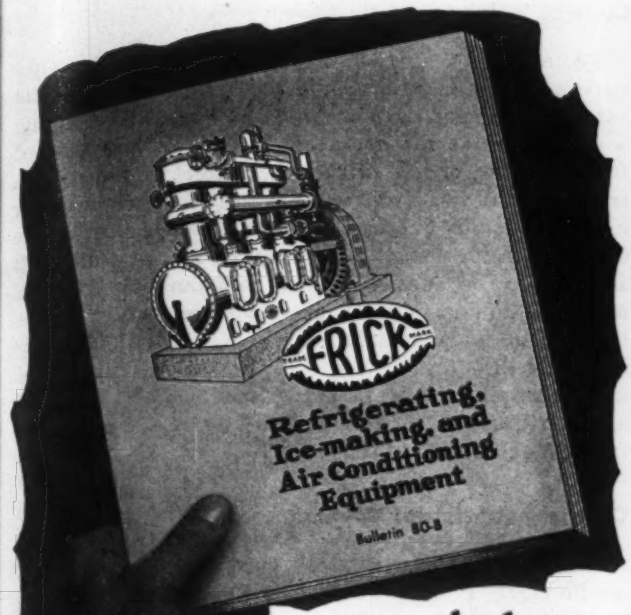

Get the latest data—write for this book!

This new 32-page Catalog, containing over 150 photographs, diagrams, and tables, gives the very latest data on cooling systems of all commercial and industrial (not household) types.

The Bulletin is printed in 3 colors, in full letter size, and has a durable cover. As shown below, it is one of the most informative books ever published on refrigerating machinery.

If you need such equipment, ask for your copy of Bulletin 80-B today. In writing, please describe carefully the cooling work you wish to do.

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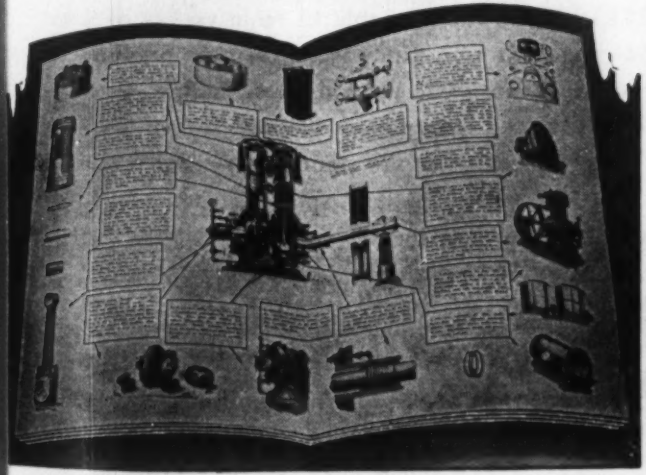
WAYNESBORO, PENNA., U.S.A.



For Insulation Jobs, too

IT HAS TO BE RIGHT THE FIRST TIME

When it comes to insulations, *"nearly right" is wrong!*

That's why it pays to get J-M Rock Cork . . . standard of the refrigeration industry for years!

Basically mineral in composition, Rock Cork has low thermal conductivity, plus high resistance to moisture, vermin and rot.

Remembering that insulation will only render its maximum efficiency when properly applied, Johns-Manville also offers an application service of skilled construction units. These units are organized to handle every detail of your insulation requirements from plans to finished job.

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Why do it the hard way ? Just snap on a SPEED NUT !

"U" TYPE SPEED NUT SNAPPED BY HAND INTO BOLT RECEIVING POSITION
PRESS DEPT.
SPEED NUTS eliminate handling of material
SNAP!

Time was when the only way to fasten a nut for blind location assembly was to weld, rivit or clinch a cage nut over the bolt hole . . . and what a job it was!

Now Speed Nuts really simplify the job. Effort is reduced. Welding machines eliminated. Less space needed. Less handling and easier final assembly . . . plus a better finished product because Speed Nuts prevent vibration loosening.

There are many types of self-retaining Speed Nuts for reducing the cost of blind location fastening. Let us show you how they can be used on your product.

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Speed Nuts
MORE THAN 3000 SHAPES AND SIZES
FASTEST THING IN FASTENINGS

Control Valves

No. 6118—The "Hy-Trol" valve, designed for pressure and flow control, liquid level regulation, and for safety equipment, is a modified globe valve employing a diaphragm as the operating means. It may be used for oil, water, or gas, with either direct or remote control. The "Power-Trol" valve is designed primarily for handling liquids or gases where an independent source of pressure for control of the diaphragm is desired. It is said to be ideally suited for handling gasoline, aromatic liquids, oils, or gases. These valves are described and illustrated in bulletin No. RC11 (146) published by the Clayton Mfg. Co., Alhambra, Calif. Small multiport pilot valves with various types of actuators and auxiliary valves for various means of remote control are also featured.

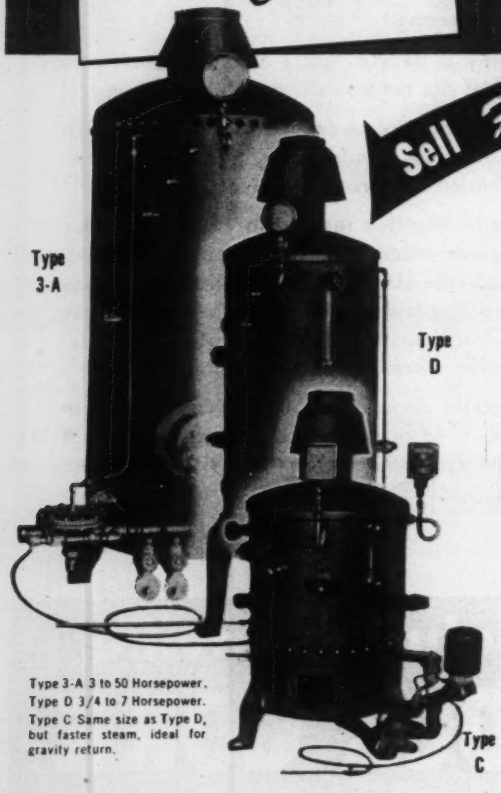
Corrosion Resistant Valves

No. 6119—Stainless steel gate, globe, check, and needle valves are illustrated in a 4 page pamphlet issued by Alloy Steel Products Co., Inc., 1506 W. Elizabeth Ave., Linden, N. J. The company's production methods and standards are also briefly covered. Technical bulletin No. 2, also issued by this manufacturer, features a discussion of the development, applications, and advantages of "Aloyco-20," a chrome-nickel alloy recommended for many valve applications. Design features of the company's line of valves, which may be obtained in various other corrosion resistant alloys and metals, are also illustrated.

Mr. Heating Contractor:

McKEE AUTOMATIC Gas Fired "STEAMBOILERPLANTS"

Sell Fast — Install Fast — Heat Fast



Type 3-A 3 to 50 Horsepower.
Type D 3/4 to 7 Horsepower.
Type C Same size as Type D, but faster steam, ideal for gravity return.

These are some of the reasons why McKee Automatic STEAMBOILERPLANTS are increasingly favored by heating engineers and contractors — and steam-generating equipment users. STEAMBOILERPLANTS are available in wide variety of sizes and types and range of applications from garment pressing to chemical processing; economical, complete Eclipse Factory-Built units, ready to install in minimum space; designed to bring a full head of steam in a hurry! Write, phone or wire for complete information; and for your customers' special steam-generating requirements, consult our engineers.

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If it's for Gas—buy Eclipse

Anybody Can Sell Water Systems TODAY . . . But TOMORROW—when Selling gets TOUGH . . . As a BURKS DEALER You'll Have What It TAKES to CLINCH Sales...

Sales Clinchers!

1—LIFE-LOK — Only on BURKS Systems—Gives Extra Years of Life to System.

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4—Shallow and Deep Well Systems.

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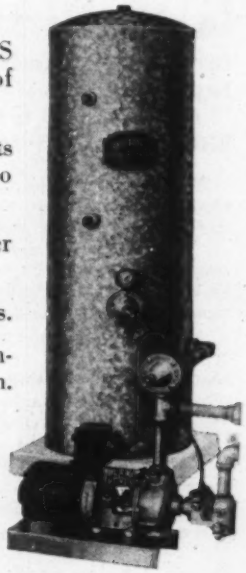

BURKS Turbine Type Educer Deep Well System

DON'T WAIT—WRITE NOW

There's a real story behind the BURKS DEALERSHIP you should know. Get full details at once.

DECATUR PUMP COMPANY

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BURKS *always* BACKS UP THE DEALER

CAN YOU USE

a motor operated shut-off VALVE

for fuel, oil and air systems that has been perfected through war production—to meet exacting postwar requirements?

Consider these advantages —

- ✔ Lightweight . . . weighs less than 2¼ pounds with aluminum body; less than 4 pounds with steel body.
- ✔ Compact . . . 6" x 3½" x 3" (approximate dimensions).
- ✔ Sturdy - Economical . . . ½ amp. at 24 v. D.C.
- ✔ Rapid operating time . . . less than 1 second.
- ✔ Dependable . . . sealed actuating unit, explosion proof.
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- ✔ Positive leakage control . . . from 0 to 50 p.s.i.; stainless steel shut-off plate sealed with spring loaded rubber rings.
- ✔ Popular sizes . . . port diameters from ¾" to 2".

If your need is shut-off valves for oil, air or fuel systems, consult Whittaker — skilled designers and manufacturers of exacting valves and accessories.

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• Like thousands of others, you ask, *"Will I be able to get a Peerless?" Yes, you will,* in the not too distant future. The big Peerless back-log of orders is being worked on 24 hours a day. The situation improves daily. Consult with the nearest Peerless Distributor now and get your order on file. Certain types of pumps can be delivered sooner than other models—so check with Peerless now. We'll do everything to deliver your needed pump as soon as we can.

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Deep Well Turbine Pumps
Vertical Types
Oil or Water Lubricated
Capacities: 15 to 30,000 g.p.m.

Horizontal Centrifugal Pumps
For General Service
Solid, Volute, and Sp'it-Case Types
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Also Jet and Water King Domestic Water Systems

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a wartime creation and..

NOW IT CAN BE SOLD

MODEL 12-D1
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NO BUZZ-NO BLAST-NO BOTHER

The Greatest Advancement in "Fan" Engineering

Seven times more circulation—33% longer range of effective cooling—greater rebound effect. Vornadofan is the new giant in air circulation. There's no standard for comparing it. See a demonstration! Safe and economical. Available in fifteen great models.

SEE YOUR DISTRIBUTOR OR WRITE DIRECT

Vornādofan
DIVISION OF THE
O. A. SUTTON CORP.
WICHITA, KAN.

Dust Collectors

No. 6120—Bulletin No. 270-A, issued by the American Air Filter Co., Inc., 107 Central Ave., Louisville 8, Ky., describes four types of "Roto-Clone" dust collectors manufactured by this company. In three types of these units the principle of dynamic precipitation, wherein centrifugal force is imparted to the dust laden air by turbine-like impeller blades, is used to obtain separation. One of these three models incorporates water sprays to wet dust particles. The fourth model is a hydrostatic baffle type wet collector. Many illustrations of industrial applications and engineering data for the selection of equipment and design of systems are included.

Electric Motor Service

No. 6121—A new 12 page booklet (No. B-3711) issued by the Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa., describes three service plans that are said to provide full service coverage for all fractional horsepower motors. A shop repair plan, an over-the-counter motor exchange plan, and a national service plan are covered. Information as to how these plans operate and who is entitled to use them is included.

Electric Motor Starters

No. 6122—Bulletin No. 14B6410, issued by the Allis-Chalmers Mfg. Co., 645, Milwaukee 1, Wis., describes the company's type "H" line of motor starters which are designed to provide complete protection for men, motors and equipment. Short circuit protection with high capacity disconnecting type power fuses, oil-immersed con-

Look for the Arm-and-Hammer

ARMSTRONG BROS.

For these quality features, specify "ARMSTRONG BROS." Pipe Vises

Hinged Vise has an *unbreakable* drop forged steel hook. Jaws are milled tool steel, the lower jaw is solid and will not kink small or thin walled pipe.

Chain Vise has patented 1-piece jaw with solid center to prevent bending of small pipe or conduit. Jaws, base, and handle are drop forged, nut is hardened, chain proof-tested.

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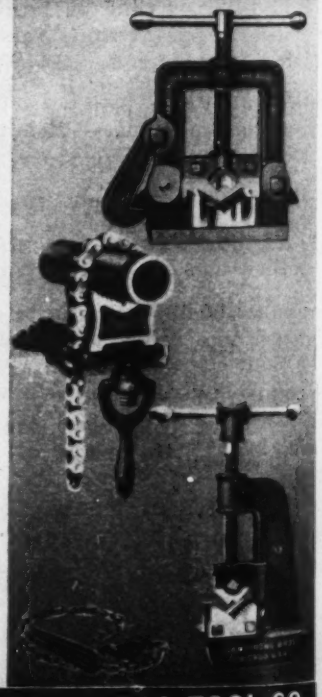


ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
355 N. FRANCISCO AVE. • CHICAGO, U.S.A.

factors, motor overload protection, safety door interlock, and factory-assembled enclosures are among the features incorporated. The starter can be used with wound rotor, squirrel cage, and synchronous motors ranging in size up to 700 hp at 2300 volts.

Electrode Chart

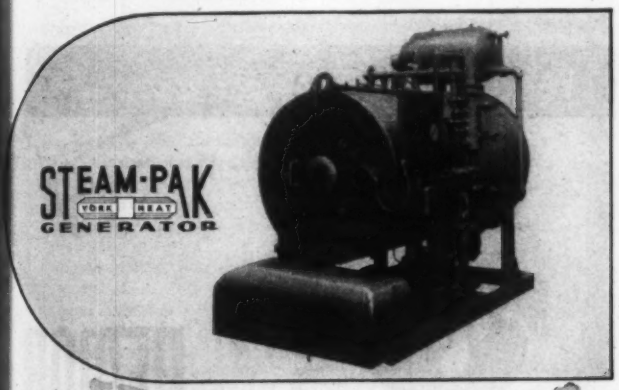
No. 6123—A 6 page chart on the proper selection of electrodes has been issued by Hollup Corp., Div. of National Cylinder Gas Co., 4700 W. 19th St., Chicago 50, Ill. This "Selectrode" chart indicates the recommended electrodes, manufactured by this company, for use with mild, low alloy, and stainless steels, for nonferrous and cast iron surfacing, and also covers gas welding rods. Suggested applications, currents, positions, and physical characteristics are included.

Fuel Loss Calculator

No. 6124—A slide rule type of calculator, for determining the per cent of heat loss in flue gases, is offered, without cost, by the Hays Corp., 782 E. 8th St., Michigan City, Ind. The device is used after the per cent of CO_2 in the flue gas, the temperature of the flue gas, and the room temperature have been determined. It may be used for several fuels of different analyses and a wide range of flue gas temperatures, making it practical for use in most boiler rooms.

Heavy Duty Relays

No. 6125—Ward Leonard Electric Co., 37 South St., Mt. Vernon, N. Y., has issued an 8 page bulletin (No.



NO WONDER AMERICA IS GETTING STEAMED UP ABOUT STEAM-PAK!

No more cluttered boiler rooms—"skid" it in, make four simple connections, and you've got a fully automatic, remarkably economical steam generator.

job-gauged units 15 to 100 h.p.—low or high pressure—using No. 3, 5, or 6 oils—for process steam or heating applications.

built right by the oil heating industry's acknowledged experts on heavy-oil equipment.

installed right by York-Shipley Distributors chosen for their engineering ability.

for lasting satisfaction a system of lifelong maintenance after installation.

GET THE STEAM-PAK STORY IN BULLETIN ID-46-ID

YORK • SHIPLEY INCORPORATED
STEAM-PAK GENERATORS • HORIZONTAL ROTARY OIL BURNERS
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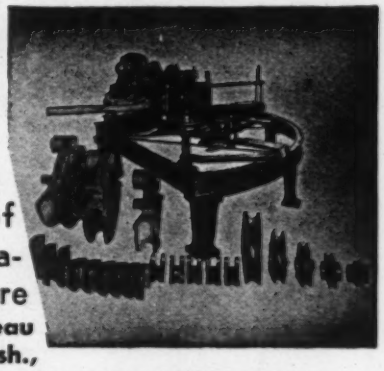
COLD PIPE, CONDUIT and TUBE BENDING MACHINES

12 types from which to select; hand operated capacities:- ¼ to 6" inclusive; motor operated:- ½ to 8" inclusive. Now indispensable to contractors, shipbuilders, ordnance plants and thousands of others. These machines will be essential also in industrial conversion after the war.

12,000 customers—and more—can testify to the indispensability of "American" machines. Here are a few users: Bureau of Ships, Wash., D. C.; Henry J. Kaiser Co., Calif:; Pacific Bridge Co.; Bethlehem-Hingham Shipyards; Hercules Powder Co.; Stone & Webster; E. I. Du Pont de Nemours & Co.; Crane Co.



"American" PIPE BENDING MACHINE Company INC — Quick Deliveries — 17 FURNACE ST., POULTNEY, VERMONT

NOW-PIPE JOINT COMPOUND in Stick Form

NO LEAKS! Just rub 3 or 4 strokes across pipe threads. It spreads and fills threads when turned.

FOR ALL THOSE PIPE INSTALLATION AND REPAIR JOBS

Always Ready For Instant Use

ECONOMICAL HANDY . . . CLEAN

Tested and Fully Approved by Independent Laboratories and Industry.

NO MESS
NO BRUSH
NO WASTE

ASK YOUR DEALER OR WRITE US

Note these FEATURES

★ Withstands gasoline, oil, butane, propane, Freon, air, water, steam, acid, gas, brine.

★ Lubricates and completely seals pipe joint threads, nuts, bolts, gaskets, turnbuckles, etc.

★ Contains no lead. Contains no injurious ingredients.

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QUALITY always counts!
MARTOCELLO Products are fully DEPENDABLE

ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, and CONDENSER WATER DISTRIBUTORS
For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their Manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost.

It will pay you to consult us. WRITE or WIRE for further information.

Jos. A. Martocello & Co. 229-231 NORTH 13th STREET PHILADELPHIA 7, PA.

Serving the Ice Industry Since 1916 "There is no Substitute for MARTOCELLO QUALITY"

130) illustrating and describing the company's line of heavy duty relays. Features, dimensions, prices, and electrical ratings are included. Single, double, triple, and four pole relays are covered. Also featured are mechanical latching relays with and without interlock contacts, and double throw relays.

Leather Belting

No. 6126—E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa., has prepared a 23x36 in. wall chart on the care of leather belting. Recommendations for the installation, operation, fastening, cutting, cementing, lacing, and for various accessories, together with formulas for determining speeds, widths, contact arcs, etc., are included.

Liquid Cooler

No. 6127—A one page bulletin (No. 100), issued by the Niagara Blower Co., 6 E. 45th St., New York 17, N. Y., describes the company's liquid cooler which is designed to furnish refrigerated cooling water, or any aqueous solution, for many industrial uses such as the cooling of water to the lowest possible temperature above freezing for air conditioning or for water cooling jackets. Capacities of units offered range from 10 to 135 tons refrigeration.

Marine Ventilation

No. 6128—A 14 page photo booklet, issued by the Ilg Electric Ventilating Co., 2841 N. Crawford Ave., Chicago 41, Ill., illustrates some of the many marine installations of fans and blowers manufactured by this

★ The New Tinnerman HOSE CLAMP

SPEED CLAMPS on aircraft oil separator pump.

SPEED CLAMP ADVANTAGES
1. One piece—no bolts, gears, thumbscrews.
2. Exclusive, self-locking, ratchet design.
3. Faster and easier to install or remove.
4. Uniform pressure provides leak-proof grip.
5. Low profile—no protruding mechanism.
6. May be used over and over again.

Write for literature
TINNERMAN PRODUCTS, INC.
2018 Fulton Road, Cleveland 13, Ohio

Speed Nuts
FASTEST THING IN FASTENINGS... OVER 3000 SHAPES AND SIZES

"Yes. Heat where you want it—"

REZNOR Gas unit heaters

1. Heating . . . trouble-free
2. Economy . . . fuel used only when heat is needed
3. Investment . . . lower
4. Maintenance . . . lower
5. Floor space . . . saved
6. Gas Fired . . . clean heat
7. Area . . . any size

★

Propeller fan and blower types. Nine sizes of each.

REZNOR MANUFACTURING CO.
Since 1888
MERCER, PENNA.

NO BOILERS • NO STEAM LINES
NO FUEL STORAGE • NO FIRE TENDING

company during the last 30 odd years. Naval vessels, transports, freighters, tankers, and tugs are among the ships illustrated.

Metal Fabrication

No. 6129—The Hungerford Corp., Big Flats, N. Y., has issued a 16 page booklet illustrating the company's metal fabrication services. The shop equipment used for cutting, forming, and welding metals together with examples of many items fabricated to customers' specifications are included.

Multiport Relief Valves

No. 6130—Multiport steam relief valves, which incorporate provisions for varying spring tension, are featured in a new publication (No. 4150) issued by the Cochrane Corp., 3131 N. 17th St., Philadelphia 32, Pa. Revised sizing data for relief valves are included and other valves such as relief, check, and overflow valves for water, air, gas, gasoline, and oil vapors are covered.

Refrigeration Equipment Testing

No. 6131—The United States Testing Co., Inc., Hoboken, N. J., has issued a 4 page pamphlet illustrating and describing the company's laboratory facilities for testing refrigeration equipment. The testing, development, and research services which are offered to the refrigeration industry are also discussed.

Refrigeration Wall Charts

No. 6132—Henry Valve Co., 3260 Grand Ave., Chicago 51, Ill., has published wall charts featuring cross sectional views of typical accessories used in refrigera-

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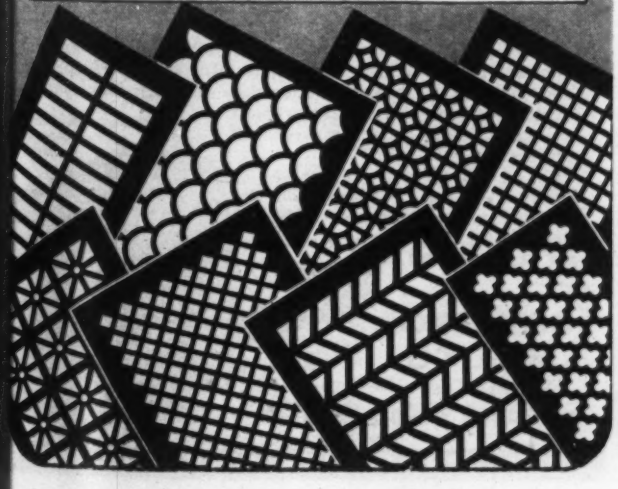

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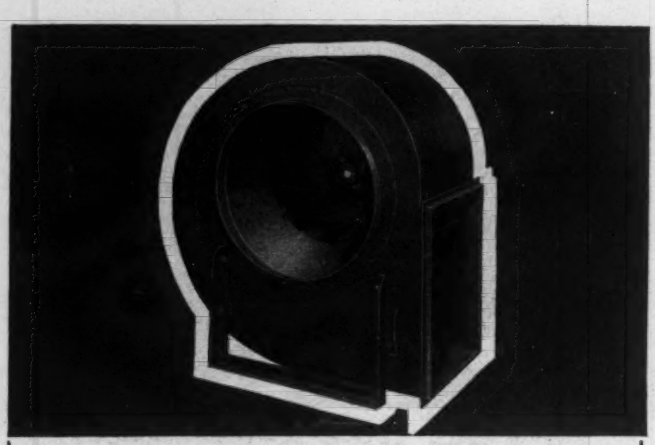
tion and air conditioning. The explanatory discussion included is factual and informative. These charts are available at no charge to colleges, trade schools, and manufacturers' service schools. They are also available to firms and institutions requesting them on business letterheads.

Resin Baking Coatings By Induction Heating

No. 6133—A paper, Resin Baking Coatings by Induction Heating, by R. J. Moore, which was presented at the 1945 fall regional meetings of the Federation of Paint and Varnish Clubs, has been reprinted in the January issue of Bakelite Review, published by Bakelite Corp., unit of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y. The author briefly tells what resin baking coatings are and describes their properties and uses prior to the war. Because of the ability to resist corrosion and abrasion, these coatings have been used for some time on drums, tanks, tank cars, vats, and a variety of equipment in the chemical processing industries. Centrifugal pump impellers, exhaust fans, blowers, and ventilators have also been successfully treated. The value of resin baking coatings for corrosion resistance in steel pipes has long been recognized. However, the time and oven equipment for baking has constituted a production handicap. During the last few years the possibilities of speedy application by induction heating, together with test results obtained during the last five years, are awakening active interest in this field, according to the author. Some of the possible applications for this relatively new process of resin baking, which are discussed, consist of coating



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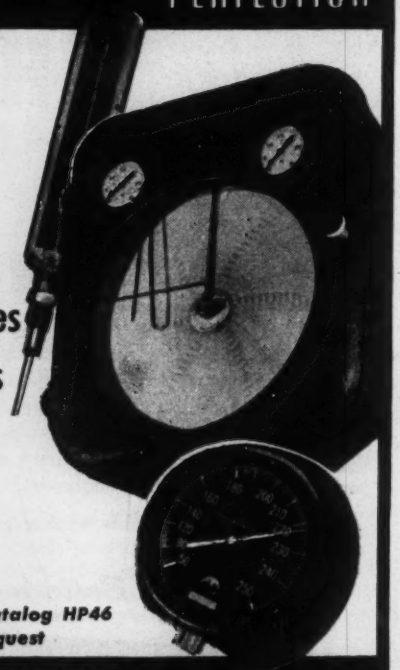

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No. 6134—The "Airfuge" combination centrifugal type separator and liquid trap, which is designed to remove moisture, oil, rust, scale, and other solids from compressed air systems, is described and illustrated in a 4 page bulletin (S-13) issued by the Swartout Co., 8511 Euclid Ave., Cleveland 12, O.

Silicone Rubber

No. 6135—The Dow Corning Corp., Midland, Mich., is issuing a series of pamphlets on "Silastic," a family of elastic silicone materials built upon skeleton structures of silicon and oxygen atoms. The first in the series of these pamphlets provides a general introduction to this silicone rubber and briefly covers its physical and electrical properties.

Silver Brazing Alloys

No. 6136—A 4 page pamphlet, Low Temperature Brazing News, No. 33, issued by Handy & Harman, 82 Fulton St., New York 7, N. Y., pictorially describes many war and civilian applications in the use of "Sil-Fos" and "Easy-Flo" brazing alloys. Designed to provide ductility, leak tightness, corrosion resistance, and strength equal to that of the metals joined, these silver brazing alloys are offered for joining dissimilar metals as well as ferrous and non-ferrous metals.

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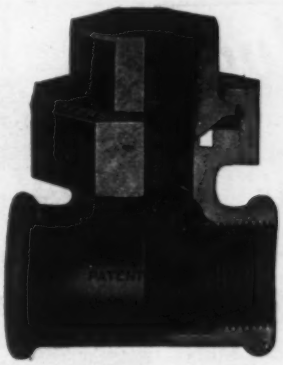

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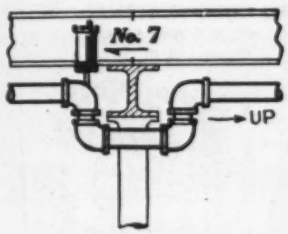

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Smoke and Combustion Control Instruments

No. 6137—Electronic indicators, controllers and recorders for smoke and combustion are described and illustrated in a new 4 page pamphlet issued by the ESI Instrument Co., 96 S. Washington Ave., Bergenfield, N. J. Also mentioned are an optical periscope for indicating smoke density and "Cat's-Eye" furnace peep hole fittings.

Solenoid and Electrically Operated Valves

No. 6138—A 38 page booklet (Bulletin E) issued by Ruggles-Klingemann Mfg. Co., 4 Foster Ct., P. O. Box 550, Salem, Mass., describes and illustrates the company's line of solenoid valves, motor operated valves and thrustor operated valves which are designed for use with air, water, oil, steam, or gas. Among the 2, 3, and 4 way solenoid valves offered are direct operated, pilot operated, external pilot operated, and solenoid trip valves.

Solenoid Valve

No. 6139—The "V5-200" solenoid valve for use with CO_2, air, water, hydraulic fluids, and other media is described in a 3 page bulletin (No. 461). Stainless steel is used for all parts which are in contact with the media. This two-way normally closed valve is available for either intermittent or continuous duty on a-c or d-c current and is rated at 10 watts maximum. It is manu-

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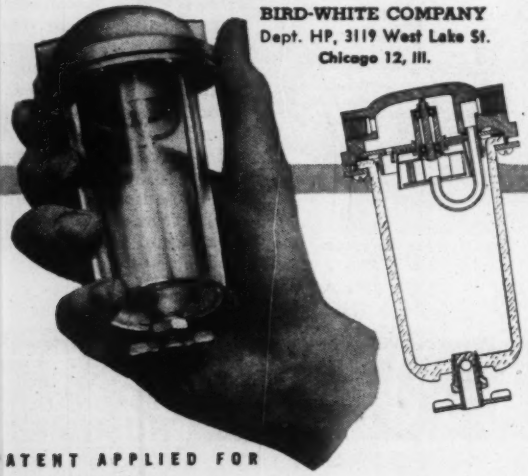

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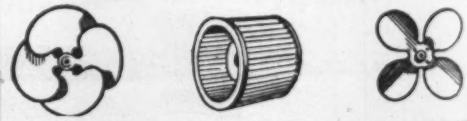

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factured by the Allied Control Valve Co., Inc., South Norwalk, Conn.

Stainless Steel Data Sheets

No. 6140—Allegheny Ludlum Steel Corp., Brackenridge, Pa., has issued new "Blue Sheets" of reference data on stainless steel castings, stainless steel Types 347 and 321, Type 416, and shock resisting steel for tools and machine parts. These file size sheets include data on physical properties, corrosion and oxidation resistance, effects of elevated temperature, and heat treating procedures.

Steam Boiler

No. 6141—The "Steam-Pak" generator, which can be adapted to burn any oil from No. 3 to No. 6, is described in a 12 page bulletin offered by York-Shipley, Inc., Industrial Div., York, Pa. Comparative performance and fuel cost data for these units are featured. The generators are offered in two series, low pressure units in various sizes up to 13,500 EDR steam rating which are recommended for heating applications in apartments, office buildings, stores, etc.; and the high pressure series (in various sizes up to 100 hp) which are recommended for dairies, laundries, process industries and other steam users.

Technical Book Catalog

No. 6142—A new catalog of technical books has been issued by the Chemical Publishing Co., Inc., 26 Court St., Brooklyn 2, N. Y. Books on chemistry, physics, science, technology, engineering, metals, building con-

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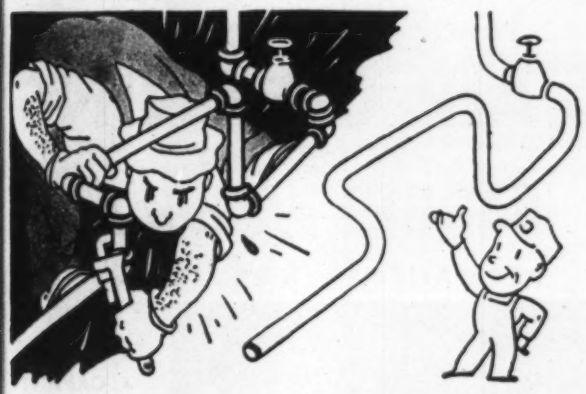

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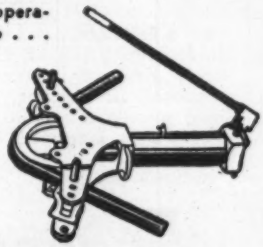

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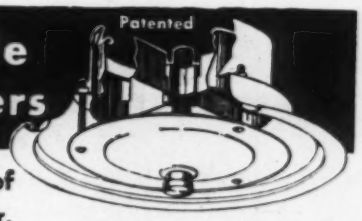

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struction, and technical dictionaries are included. The catalog gives the date of publication, the price, number of pages, a description, and full table of contents for each book.

Thermal Insulation

No. 6143—Recommended for use on hot surfaces up to approximately 300 F and available in four-ply and six-ply air cell construction, "Careycell" asbestos insulation is described in a booklet recently issued by the Philip Carey Mfg. Co., Wayne Ave., Lockland, Cincinnati 15, O. Specifications for combatting excessive humidity, insulating hot water and steam pipes, boilers, air conditioning, and various heating appliances are given and methods of installation are described.

Thermal Insulation Material

No. 6144—The Owens-Corning Fiberglas Corp., 1842 Nicholas Bldg., Toledo 1, O., has published a 28 page booklet (Fiberglas Standards A3.2.1) which describes and illustrates five types of thermal insulation material offered by this company. Design and application data for equipment manufacturers are also included and many illustrations are used to demonstrate application details.

Torque Wrenches

No. 6145—Torque wrenches, designed to provide predetermined tension on nuts, bolts, studs, etc., are described in a new 12 page folder issued by the Jo Manufacturing Co., 8442 Otis St., South Gate, Calif. Torque ranges from 5 to 1600 in.-lb are available in the various

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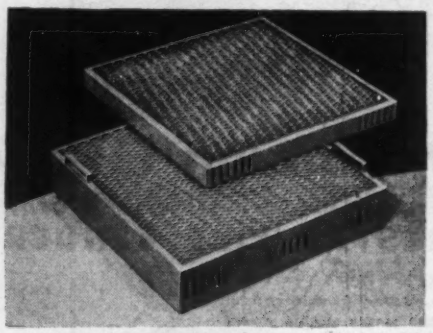

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Turbine Well Pump Performance

No. 6146—Influence of Ground-Water Level on Turbine Well Pump Performance by P. J. Equi was published in the April 1945 issue of Industry and Power. Reprints of this article (bulletin RP-277) are offered by the Worthington Pump and Machinery Corp., Harrison, N. J. The author, chief engineer of the vertical turbine pump division of this company, discusses the loss in output caused by a receding level of underground water. The remedy for such a condition is illustrated by means of a typical example and details of a simple water level measuring device are included.

Valves and Fittings

No. 6147—Piping in the C1-B class maritime cargo vessels, design problems and procedures in the development of lift check valves, and special piping problems encountered in connection with "Dowtherm" systems are among the topics featured in the March issue, Vol. 12, No. 2, of Valve World, the house organ of the Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.

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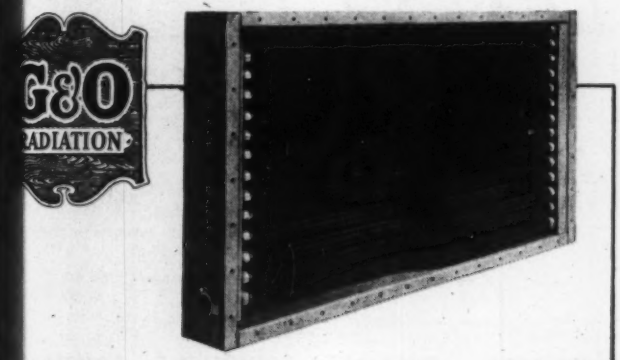

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